

A JURIDICAL ANALYSIS OF
DIRECTED-ENERGY WEAPONS IN THE
EARTH-SPACE ARENA.

Edward Anthony Fessler



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A JURIDICAL ANALYSIS OF DIRECTED-ENERGY WEAPONS
IN
THE EARTH-SPACE ARENA

By

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All source material employed in the research and preparation of the following study is unclassified. The writer neither sought nor accepted access to any classified information in connection with this project. Except as explicitly indicated, any description, analysis or opinion expressed herein is exclusively that of the writer and in no way reflects the views of the United States Government, its departments, agencies, branches or services or The George Washington University.

I

THE ADVENT OF THE DIRECTED-ENERGY WEAPON

The task of maintaining minimum order, understood as freedom both from severe deprivations by unauthorized coercion and violence and from expectations of such deprivations, has long been recognized as one of the most difficult and frustrating problems of mankind. The newly acquired access to space under conditions of a highly disunited world arena and the existence of apocalyptic weapons of mass destruction can only magnify the already formidable difficulties of this problem. Man's penetration into space has not only immensely expanded the area of human interaction, transforming the earth arena into the earth-space arena, but has also in parallel evolution brought about the development of many new instruments of violence which greatly aggravate both the threats to minimum order and the difficulties in establishment of appropriate techniques for its maintenance. Recent technological developments ... have brought any target in the earth arena within quick reach of unbelievably destructive means of violence.

McDougal, Lasswell, and Vlasic¹

An intense arms competition between the two superpowers, the Soviet Union and the United States, has been the preeminent challenge to the maintenance of minimum public order since the close of World War II. Through both bilateral arms control negotiations between the superpowers and a variety of related multilateral agreements involving additional state participants, the minimum public order system may recently have been strengthened. Premised upon the assumption that minimum public order is

enhanced if strategically significant instruments of coercion are controlled, these initiatives have sought to prohibit or limit arms through restraints upon the size, type, use and even areas of deployment of major weapons systems. These initiatives have assumed that such restraints serve the minimum public order by reducing incentives to compete in research, development and production of advanced weapons of mass destruction.

While these efforts have provided at least a minimal restraint on the existing instruments of mass destruction, they have not served particularly well to discourage overall arms competition between major participant states. Evidence is mounting that the specter of a terrifying new mode of warfare designed to function in an expanded earth-space arena has arisen on the technological horizon. Although much of the available information on this new mode of warfare is subject to strict government classification, an increasing quantity of unofficial, technical and scientific literature is piercing the veil of secrecy surrounding the development of such "Star Wars" weaponry as high-energy lasers, particle-beam death rays, plasma jets and antisatellite interceptors.²

The inventory of weaponry under development includes an extensive variety of futuristic devices, some of which may soon exhibit the potential to shatter the strategic equilibrium between the principal powers. Some of the technological innovations which even now pose an imminent and fundamental challenge to the continued maintenance of minimum public order are classified under the generic heading of "directed-energy weapons."³ To assess a few of the more significant juridical implications arising from the advent of directed-energy weapons, it is useful at the offset to consider the circumstances which surrounded their discovery and early development.

An application of pertinent international law to these devices requires

at minimum a broad general understanding of their technical capabilities, characteristics, limitations and probable military impact. A sufficient resource of unofficial technical literature is now available to permit this preliminary survey of the directed-energy weapon.

A. The High-Energy Laser

1. Research and Development

A means of directed-energy propagation which has received broad recognition in recent years is the process referred to as "light amplification by stimulated emissions of radiation," commonly known by its acronym, "laser." As a result of quantum physics research during the 1950's, it was discovered that a beam of intensely concentrated and directed light had a variety of useful applications in both science and industry. Peaceful applications of the laser developed through early research included precision measurement, surgery, communications, computation, manufacturing and construction.⁴ These peaceful applications of the laser as well as a limited number of tactical military uses developed for it, including precision guided "smart bombs" employed in the later years of the Vietnam conflict, used relatively low intensity light.

As basic research continued to probe this new form of energy propagation, it became increasingly apparent that lasers of greatly increased intensity had significant military potential and were particularly efficient in the near vacuum of outer space.⁵ Both superpowers demonstrated an early interest in the high-energy laser's military potentialities and initiated significant research and development programs. In a 1966 United States Air Force test conducted at Kirkland Air Force Base, New Mexico, the potential destructive force of the high-energy laser was impressively demonstrated by using a beam to incinerate a hole in firebrick in as little as five seconds.⁶ By the late

1960's, the U.S. Department of Defense had been persuaded of the high-energy laser's overwhelming weapons potential.⁷ In Fiscal Year 1968, Congress appropriated \$8 million for a program of basic research and development. By Fiscal Year 1973, research and development funding levels had increased tenfold to \$85 million.⁸

During this early period, each of the three U.S. military services implemented its own research and development program specially tailored to the respective organization's particular mission. While the Army experimented with the concept of a land-based electric discharge laser (EDL), the Navy pursued basic research into chemical lasers for possible shipboard use in antiaircraft or antimissile defense. The initial Air Force research program concentrated on yet a third concept, the gas dynamic laser (GDL) which it was hoped might prove effective in such military applications as heavy bomber defense.⁹ Additional research with its principal focus upon more advanced outer space applications was coordinated by the Defense Department's Advanced Research Projects Agency (ARPA), an organization typically tasked by the DoD with higher risk defense research and development programs.

While United States high-energy laser research and development programs expanded rapidly in the late 1960's and early 1970's, the Soviets pursued a similarly ambitious effort. In 1974, the Central Intelligence Agency estimated that the Soviets were spending approximately the equivalent of a billion dollars a year for high-energy laser research and development.¹⁰ Available assessments of Soviet laser research vary considerably and are no doubt subject to sometimes unreliable intelligence estimates. Nevertheless, there are strong indications the Soviet Union has a keen interest in developing a space warfare capability. In this connection, the Soviets are thought to be pursuing an active high-energy laser weapons research and development program.¹¹

Evidence is increasing that this competitive research and development thrust may soon produce operational weaponry with devastating potential. According to one report, the Soviet Union was prepared in early 1978 to commence testing a series of hydrogen fluoride high-energy laser weapons at its Sary Shagan facility near the Chinese border. The Sary Shagan facility is considered by some intelligence experts as a principal location for Soviet antiballistic missile research. A number of new facilities observed at the site are believed indicative of Soviet aims to develop high-energy lasers or other directed-energy weapons possibly using a particle-beam or microwave radiation.¹² High-energy laser tests at the Sary Shagan site are believed to be part of the overall Soviet program to develop an effective means of incapacitating or destroying the critical outer space resources of adversaries. Such a capability would be strategically important in the event of any future war.¹³ Possibly corroborating evidence of Soviet advances in this area may be inferred from reports indicating that some U.S. experts believe a recent Soviet rocket launch series actually tested space vehicles designed to carry laser weapons.¹⁴

The United States is clearly taking Soviet research and development efforts seriously. A large number of U.S. aerospace and technical companies are now under contract to the Department of Defense to improve satellite "survivability" and develop defenses against attacks from lasers or antisatellite interceptor vehicles. The Perkin-Elmer organization is developing a satellite optical sensor known as the "Laser Radiation Receiver" (LRR) for use in the detection and classification of overt radiation aimed at disrupting sensitive satellites. Aerojet Electro Systems is under contract to research and develop measures to counteract laser jamming of space vehicles. The TRW Corporation's Defense and Space Systems Group is using simulation testing to investigate satellite vulnerability to laser attack. Science Applications Incorporated of La Jolla, California,

is reportedly engaged in evaluating laser countermeasures. These and other government contracts are a clear indication that the United States Government regards the potential for the eventual deployment and possible use of laser weaponry as real.¹⁵

There is also mounting evidence that the United States programs, while continuing to focus on fundamental technological problems, have succeeded in developing at least experimental high-energy laser weapons. Although these devices are not prototype weapons *per se*, they do demonstrate the potential application of this new technology to defense missions.¹⁶ The U.S. Army has developed a mobile test unit (MTU) which employs an Avco-built electric discharge carbon-dioxide laser installed in a LVTP-7 Marine Corps amphibious-landing tracked vehicle. The MTU underwent tests as early as 1975 at the Redstone Arsenal Missile Test Range to check both reliability in rough simulated battlefield terrain as well as specific high-energy laser (HEL) target tracking efficiency.¹⁷ The Army has also pursued research and development of a helicopter mounted laser weapon (HEMLAW) and certain infantry laser devices (INLAW).¹⁸ Additionally, the Army carries on research into laser vulnerability.

Another indication of the relatively advanced stage of U.S. experimental laser weapon research is the U.S. Air Force's Airborne Laser Laboratory (ALL). The ALL employs a Boeing KC-135 jet aircraft as a platform for an experimental gas-dynamic laser. Although the ALL was never intended as a prototype for an operational weapons system, its GDL device has been fired in flight for periods of from twenty to thirty seconds. Such tests demonstrate at least the potential for carrying directed-energy weapons aloft as antiaircraft or anti-missile bomber defense systems. As of 1975, the Airborne Laser Laboratory was considered the most advanced of the military testbed facilities.¹⁹

While there is as yet no official indication of the U.S. Navy actually installing a high-energy laser or HEL on board a vessel, disclosures have

suggested that a fleet defense test weapon is under development in cooperation with TRW and other defense contractors. Recent success in developing an efficient chemical laser has been the impetus for funding the construction of the Navy's sophisticated "Baseline Demonstration Laser" (BDL).²⁰ The Navy system is reported to employ a deuterium fluoride chemical laser. A number of additional related programs are also underway to study ocean propagation, anti-ship missile defense and related areas of HEL research.²¹

Estimates suggest that by the end of the current decade, the United States will have spent approximately three-quarters of a billion dollars on research and development of the HEL.²² The ultimate question facing decision-makers concerned with eventual acquisition of these devices will probably hinge on factors related to cost effectiveness, military strategy and policy. To appreciate some of these key factors, including the central policy question of the legality of such weapons, it is important to consider the known capabilities, characteristics and limitations of the HEL as an instrument of coercion.

2. HEL Characteristics and Capabilities

The official secrecy surrounding government sponsored research into high-energy lasers makes an appraisal of their probable characteristics and capabilities difficult. Because of both this government classification and the fact the HEL is new to weapons development, some level of extrapolation is necessary in discussing prospective systems. It is certain however, that a number of different types of high-energy lasers are considered to exhibit weapons potential. While this study will tend to generalize as to the overall concept of a HEL, it is useful to understand that to some extent, the characteristics, capabilities and even limitations of this category of directed-energy

weapon may depend upon its particular features or the means by which it propagates its beam.

One of the prominently mentioned systems used in propagation of destructive laser energy is the "eximer laser." The eximer laser generates its beam by use of electrically excited rare gas halogen (RGH) or alternatively, some other rare gas. This particular system emits laser beam energy in the visible and ultraviolet parts of the spectrum. Eximer beams can direct considerable force at a target and are considered strong possibilities for ground-based use against hostile satellites. A principal attribute of the eximer laser is its relatively small optical system.²³ Some alternative laser systems are hampered by cumbersome optical components.

One of the first systems developed in the U.S. program was the gas dynamic laser (GDL). Early model gas dynamic lasers used carbon dioxide as an operative gas heating it to high temperatures and causing it to expand. The carbon dioxide was then cooled by supersonic passage through nozzles with the resultant high energy being given off in a continuous wave through a mirror cavity.²⁴ Although it was initially thought that the GDL system might prove promising, subsequent research indicates it has definite drawbacks. The system requires substantial amounts of fuel or power and also must be fed with expendable lasing gases.²⁵ In addition, there are problems in heating the working gas. As noted, the U.S. Air Force ALL testbed facility employs a GDL system. The most likely applications for the GDL are in permanent ground-based weapons, aboard ships or possibly on large bombers. In view of its consumption of resources, it is less attractive for use on board spacecraft. Moreover, where light, mobile military vehicles are required, the GDL system is too demanding of both resources and limited space to be an efficient weapon.

In addition to these systems, the United States is intent on further investigating the possibility of a an efficient electric discharge laser (EDL).

The EDL possesses the advantage of being able to propagate energy employing either continuous wave or successive pulses. It also has the advantage of relative simplicity when compared with alternative lasing systems. This system transmits a shorter wavelength beam which authorities report physically permits more efficient propagation and focusing.²⁶ The principal disadvantage of the EDL devices developed to date is their voracious appetite for electric power which is not easily provided on board mobile military vehicles or platforms. Because of its characteristics, the EDL system is most likely to find applications on board larger military vehicles such as ships and heavy bombers or in permanent land-based facilities. Some effort is being made to develop more efficient generators, capacitors and other electrical power equipment. If this effort is successful, the potential military applications of the EDL could increase greatly.

The most promising of all high-energy laser systems now under development is the chemical laser. Considerably more complex than some of the alternative systems, the chemical laser uses chemical reactions to achieve power outputs. This system can propagate its directed-energy through hydrogen fluoride or a variety of other substances which generate a beam with little external electrical resource demand.²⁷ Chemical lasers have been developed which produce pulses of 200 billion watts for 20-billionths of a second. Such forces are sufficient, even in a short pulse, to vaporize metal and produce destructive shock waves in the target.²⁸ These systems operate at shorter wavelengths (2.6 to 5 microns) than alternative systems, a technical feature which reduces atmospheric attenuation and increases thermal damage effects to the target.

The principal drawback to present generation chemical lasers is that they may require hard-to-handle chemical reactants which may prove corrosive or

dangerous to combat personnel. Nevertheless, chemical laser beams can be more intensely focused for any given size optics, show good atmospheric propagation characteristics and can be generated from smaller, lighter, more mobile components. ²⁹ The characteristics and capabilities of the chemical laser make it a probable choice for an extensive variety of mobile weapons applications including aboard spaceborne systems.

These and other laser propagation systems under development exhibit a number of distinctive operational features. Conventional and even sophisticated nuclear or thermonuclear weapons systems often require considerable personnel resources for their operation. Combat personnel may be required in such processes as loading, maneuvering, target selection or analysis and execution of the actual firing orders. In contrast, it is probable that advanced laser weaponry will be employed to its best advantage when used in a fully automated, computer guided mode. Threat analysis, target selection or prioritization and the decision to fire may all be programmed into an integrated weapons system. This may be particularly true if the weapon's principal mission is one of limited deterrence or response to a preceding act of aggression.

While the probable automation of laser devices will significantly reduce the analysis and response time which results from human decision-making, the laser system itself will effectively eliminate the usual payload delivery time factor through direct transmission of its coercive force to the target at the speed of light. ³⁰ Whereas conventional explosive devices, chemical and bacteriological agents and even nuclear or thermonuclear warheads achieve their effect by means of a delivery system which necessarily requires a lapse of time between the decision to attack and the arrival of the coercive force on target, the high-energy laser continuous wave or pulse is instantaneously beamed to the target in the form of pure energy, a concept completely unique to warfare.

The fact that such a weapon fires no mass also means it requires no heavy or sophisticated adjustment mechanisms to compensate for inertia.³¹ The zero time-to-target characteristic may also have the effect of preventing the target under attack from taking defensive action. It may be possible for a directed-energy attack to be perpetrated without giving an adversary target the opportunity to shield itself, take evasive action or launch a defensive counterattack from the same point.

Yet another important characteristic of the high-energy laser is its precision controlled targeting capabilities. Using a measured burst of focused energy, it may eventually be possible to precisely and discriminately aim the coercive force against only the selected objective.³² However, the technical literature admits that present generation experimental lasers may create most undesirable ancillary injury. The U.S. Navy in developing its Baseline Demonstration Laser expressed concern that injury might occur to personnel on board friendly ships and aircraft in the vicinity of the powerful chemical lasing device. The firing of powerful laser systems can cause both cornea damage to the eyes and other forms of personal injury in zones outside the selected target zone itself.³³ Although this problem may be solved by friendly personnel wearing special goggles to attenuate the HEL radiation to safe levels, such solution may be ineffective if the laser is used in the vicinity of noncombatants not similarly equipped.

Relatively little information has been publicly disclosed describing the specific destructive effects of the high-energy laser beam on various targets. What is known, however, is that direct destruction occurs when the intense light creates a thermal reaction in the target. This brings on melting, incineration or vaporization of the objective depending upon exact composition of the target and the intensity of energy transmitted. Destruction may also result

from the creation of shock waves in the target.³⁴ In addition to these effects, the HEL may cause secondary destructive reactions to occur. A plasma which is sometimes created when a high intensity beam vaporizes metal may itself generate destructive X-ray radiation. Such X-ray radiation will under certain circumstances produce structural damage to delicate spacecraft or aircraft components.³⁵ Presumably, excessive amounts of such X-ray radiation absorbed by the human body would also result in significant personal injury.

In addition to the potential for eye damage and typical burns which result from the HEL being used against personnel targets, other personal injury may occur. The body will also sustain personal injury resulting from the shock effects often generated by a laser weapon. In addition, pressure injuries may result as well as special effects to particular tissues. The HEL is also thought to have somewhat unusual effects upon the body's blood chemistry.³⁶ In general, use of an HEL weapon against personnel will tend to produce substantial personal injury much of which will be extremely painful if not lethal.

At least two characteristics of the HEL beam destruction are particularly unique and bear mention for purposes of assessing the overall legality of these new systems. First, the laser's thermal and shock effects on particular targets and individual target components is apt to vary considerably with wavelength of the beam, whether it is continuous or pulsed, the speed of the target through a medium and the chemical composition of the target. As a result of a series of complex processes which are setup when a beam strikes a particular target, these various factors will greatly influence the type and extent of target damage. For example, in the case of an aircraft, it is likely that destructive lasing would initially result in the vaporization of the plexiglass canopy. This occurs because the canopy is made of a material which tends to ablate sooner than the largely aluminum body of the aircraft superstructure itself.³⁷

A related but distinct characteristic affecting laser destruction is the variable impact of impulsive (shock) loading on a rapidly vaporizing target. Shock waves are thought to be a counteraction to the "blow-off" of the cloud of vaporized material which is generated when the laser pulse hits the target causing the onset of thermal destruction. Whether these shock waves are created and the degree of their intensity in turn is a function of many of the same factors which determine the laser's thermal effects on the target.³⁸ Hence, the creation of shock destruction in the target may, as in the case of thermal damage, be a somewhat controllable function of such variables as beam intensity, wavelength and target composition.

Initial tests have demonstrated that in general, impulse waves transmitted to easily ablated materials such as plexiglass and lucite may cause 100 times the shock potential experienced in materials such as aluminum and titanium. The import of this phenomenon is that lasers may produce destructive effects on their targets in ways which are subject to great variation depending upon particular circumstances. In the case of an aircraft, this phenomenon would probably bring initial disabling damage about through canopy shattering. Such circumstance would subject the crew to imploding debris and rapid depressurization. Disabling damage to a surface vehicle, vessel or even spacecraft might occur instead through direct thermal damage or in consequence of shock waves acting upon some other vulnerable component. In other words, it should not automatically be assumed that effects of a HEL weapon on one type of target will necessarily match the effects on another. This could be important if, for example, decision-makers wished to avoid the use of HEL weapons against personnel. Although in surface warfare, lasers could be expected to cause direct thermal and shock injury to ground troops, personnel in aircraft would probably be disabled by indirect effects brought on by antiaircraft lasing. At such time as decision-makers consider possible limitations on the use of the HEL weapons, many of these

complex effects and interrelationships will have to be studied carefully.

3. Limitations and Countermeasures

While the high-energy laser demonstrates substantial potential as a destructive force, it is still subject to a number of important limitations. These limitations are the result of a combination of basic physical phenomena, technological barriers, environmental or meteorological conditions and probable defensive countermeasures. A set of noteworthy limitations stemming from physical phenomena and concomitant technological barriers is currently the focus of intensive research. These limitations are sometimes classified under the headings "propagation" or "attenuation."³⁹

One aspect of the propagation or attenuation problem entails the absorption of beam energy by water vapor and carbon dioxide in the atmosphere. This problem is particularly troublesome in the lower atmosphere and, in particular, in areas of great humidity such as over or near large bodies of water. Other forms of absorption, scattering and beam spreading, are induced by particulate matter naturally suspended in the air and variations in the refractive index along the laser beam's path resulting from density variations.⁴⁰

Researchers have also discovered a phenomenon known as "thermal blooming" which occurs when air in the beam's path is heated by radiation energy causing a change in the index of refraction and defocusing of the beam.⁴¹ Developers are probing yet another limitation characterized by a self-defeating plasma created in the beam's path. This plasma is generated artificially by the electrical breakdown of the air between the laser source and its target. The plasma absorbs the greater part of the laser's destructive energy and serves to shield the target.⁴² Plasma may also be generated when certain types of materials within the target itself vaporize creating a protective reflective or energy absorbing cloud. The resultant vaporized cloud tends to again reflect or

absorb the greater part of the laser's energy defeating the beam's impact on the target.

Propagation or attenuation problems are amplified by ambient meteorological or environmental conditions such as fog, rain, snow, clouds or even common air pollution.⁴³ These limitations have caused Philip J. Klass and other technical authorities to speculate that while the laser may be ready for use in the near-vacuum of outer space, it may be some years before it can be efficiently employed in the denser parts of the earth's atmosphere. Skeptics point out that the limitations on laser propagation are such as to render it too unreliable to be used as a source of air defense or in any other capacity in the traditional terrestrial theaters. They argue that no military commander would want to depend upon any weapon which could only be efficiently utilized in ideal weather or atmospheric conditions.⁴⁴ If it is assumed that these various terrestrial based limitations can not be overcome in the foreseeable future, then the HEL skeptics may make a persuasive point. However, there is no contesting the fact that major participants continue their research and development programs into overcoming these various limitations. This continued effort tends to suggest there must be some cause for optimism that the most troublesome problems may eventually be overcome.

The high-energy laser also has certain limitations related less to the physics of the beam and more to the operation of the weapon itself. At the present time, many types of lasers still require more electrical power than can be efficiently and economically generated on board a highly mobile military vehicle or platform. Weapons developers could increase the size of the laser's supportive platform to accommodate increased power generation equipment. However, by doing so they also tend to increase costs of construction and operation of the vehicular platform. Moreover, enlarged platforms tend to be

less maneuverable and more vulnerable to defensive counterattack. A closely related problem which plagues some HEL systems is the necessity for large, high-power optics. Critics also note that lasers will almost certainly demand more sophisticated precision pointing and tracking mechanisms if they are to efficiently keep their beam locked-on to their targets long enough for thermal and shock destruction to occur.⁴⁵

One further physical drawback of the HEL weapon is the necessity that it be operated in a line-of-sight with its target. Unless reflective intermediate supports are used, a laser weapon must be in a direct line-of-sight path with its military objective. This particular limitation tends to emphasize the defensive role of the high-energy laser over its potential offensive roles. Since offensive weaponry carries the attack to the enemy, an attacker wishing to use the high-energy laser as a weapon must deploy his device so that it has a straight shot at the target. Obviously, such deployment and maneuvering of the HEL device complicates the military mission and imposes additional requirements on the military planner.

Available defensive countermeasures also represent a limitation to the HEL weaponry. Any action by a defender which increases the attenuation could be employed as a countermeasure. Within the earth's atmosphere, countermeasures might include smoke screens generated by standard smoke generators.⁴⁶ Potential space targets could be surrounded with an artificial cloud of small aluminum particles to reflect and disperse incoming HEL beams. Alternatively, these potential target vehicles could be equipped with an outer skin made of highly reflective material designed to redirect the beam energy. Potential targets can also be "hardened" by making them of material which does not ablate easily and by placing delicate components toward the less exposed interior of the vehicle.

Development of these various countermeasures is advancing beyond the experimental stage. Authorities reveal that most, if not all, U.S. defense oriented navigation, reconnaissance, early-warning and communications satellites to be launched in the next ten years will receive electrical power from internal nuclear sources or fuel cells vice the more vulnerable, exposed solar panels previously employed to power space satellites.⁴⁷

A number of less direct countermeasures are also prominently mentioned. Decoy vehicles, particularly in space, could serve to confuse the potential laser attacker, immeasurably complicating target acquisition and analysis. Certain potential targets could also be made more maneuverable and be programmed to take evasive action when under laser attack. In the instances of essential military resource satellite systems, it has been suggested that a latent redundancy be created by launching so-called "dark satellites" which could not be easily tracked and which would remain essentially hidden in orbital space zones until activated by a coded command from a possessor participant.⁴⁸ Proponents of these clandestine space resources argue dark satellites would be immune from attack until such time as the HEL equipped attacker became aware of their existence and could get a fix on precise coordinates for purposes of targeting.

Without question these various limitations and potential countermeasures represent significant barriers to the production, deployment and possible use of the HEL weaponry. Nevertheless, significant progress has already been made to resolve many of the technological and apparent physical barriers. Many experts in the field are convinced that most of these drawbacks will eventually be overcome by participant developers. Defense systems authority William J. Beane, while admitting formidable technological limitations exist, nevertheless contends that if the past decade is any indication, the principal problems

standing in the way of an operational HEL system will be successfully overcome. Beane concludes an analysis of the strategic implications of the high-energy laser in these words:

To be sure, there is no certainty at this time as to when a breakthrough will be made on the feasibility and practical use of a high-energy laser. Nor is it possible to predict what effect it may have on existing strategic weapons systems. But few will deny that the solutions to the problems will be met, and that its impact will be tremendous on the international community. One can easily forget that less than twenty years ago only a few years before the first ballistic missile submarine was deployed in November 1960-technically competent people deemed the Navy's Polaris weapon system impossible. The forging of this new, revolutionary technological instrument may well hasten the transition from the Nuclear Era to the Laser Age.⁴⁹

The ongoing U.S. Defense Department program to improve space vehicle survivability against high-energy laser and other forms of antisatellite attack provides tangible evidence in support of Beane's contention.⁵⁰ It is unlikely that this substantial defense effort would be made if military and intelligence planners did not consider the laser a credible threat to U.S. space resources. Additional evidence which strongly suggests that limitations are not viewed as an immutable barrier to eventual operational weaponry arises from the fact that while the U.S. Defense Department's overall budget request for HEL devices dropped by 10% to \$150 million in figures submitted in early 1977, ARPA's appropriation request for "space-based lasers and related technology climbed 16% to \$24.9 million from figures presented for the previous period.⁵¹

4. Strategic Implications

Despite its limitations, the laser's lethal capabilities are conducive to a wide range of military applications. Beane's analysis catalogues a few of the more apparent applications:

A listing of possible strategic uses of high-energy lasers would read as follows: satellite destruction, blinding or defense; burnout of space sensor systems; point defense (antiship missile defense); detonation of nuclear warheads; disruption of radar and

communications networks; range detection, bomb destruction or defense; ICBM or SLBM missile defense either by destroying the missile (second stage) while in flight or by damaging or setting off the warhead in space. The results of laser research, test and development to date suggest that such uses are to be more ruled in than ruled out.⁵²

Beane's inventory, while far from exhaustive, illustrates a few of the more apparent military applications of the high-energy laser. As Beane notes, the high-energy laser may eventually find its place in the surface and atmospheric theaters. However, its first major challenge to the minimum world public order system will almost certainly result from its introduction into the functional orbital zones above the earth's atmosphere referred to as "near-earth space" or simply, "near space."⁵³

Ground or seaborne lasers designed for use against targets in near space as well as spaceborne lasers themselves may eventually have the capability to provide a credible defense against major weapons delivery systems such as the ICBM, manned bomber or even cruise missile. An even more immediate impact stems from the increasing dependence of the Soviet Union and the United States upon sophisticated meteorological, navigational, early-warning, reconnaissance, communications and earth resources satellites. The development of a device capable of rapid incapacitation or destruction of such essential space vehicles raises a series of troubling questions as to the continued dependability and stability of the existing strategic balance of power between the superpowers and their allied blocs.⁵⁴

The potential efficiency and coercive capabilities of the high-energy laser influenced William Beane to cite from authority James Canan's *The Superwarriors, The Fantastic World of Pentagon Superweapons* in making this observation:

Like the atom bomb, the high energy laser has the potential of producing a revolutionary change in weapon systems that could alter prevailing concepts and tactics of warfare. When perfected, the high-energy laser could abruptly 'upset the balance of today's offensive and defensive tactical and strategic weapons, superseding all of them as the penultimate defender and destroyer, capable of turning men into messes of mush, their machines into molten metal.'⁵⁵

With particular reference to the political impact of the spaceborne HEL on world community perceptions, George H. Heilmeiser, Director of the U.S. Defense Department's Advanced Research Projects Agency (ARPA), testified before the House Armed Services Committee in early 1977: "It is my belief that the high-energy laser in space could represent a Sputnik like event - a technical achievement which could influence the perceptions of foreign countries as to who is the leader in defense-related technology."⁵⁶ Even more recently, statements submitted to the 95th Congress pursuant to the Arms Control and Disarmament Act observed: "There is little doubt that laser weapon development is considered to be an area of military technology having both high priority and prestige value in both the Soviet Union and the United States."⁵⁷

In short, it is clear that the advent of high-energy laser weapons capable of operating in or through the near space theater will greatly enhance the possessing participant's technological resources thereby increasing its bases of power. Moreover, possession of HEL weaponry may well serve to enhance the apparent military prowess of participant states. The increase of these participant bases of power may in turn increase the expectations and perceptions of strategy or policy options available to state decision-makers. These new weapons may also precipitate certain changes in the minimum world public order system through the modification of existing claims and counter-claims. The high-energy laser will almost certainly give rise to new sets of claims particularly oriented toward coercion in the earth-space arena.⁵⁸

B. The Particle-Beam Weapon

1. Research and Development

Another type of directed-energy weapon is the category classified as a "particle-beam weapon" also referred to by some sources as an "atomic death ray," a "heat ray," the "charged-particle beam" or simply by its acronym "PBW." Until very recently, information relating to the particle-beam weapon was almost completely limited to highly selected participant elites in the scientific, defense and intelligence communities. Whether the PBW is technically feasible within the immediate future and to what extent one or both superpowers are engaged in research and development has been until recent months a matter of great controversy in U.S. defense and intelligence circles.⁵⁹ It is not the purpose of this study to attribute credibility to either of the major positions taken in this strategic debate. What is important however, is that most experts agree the particle-beam weapon, like its counterpart the high-energy laser, remains a distinct technical possibility in the not too distant future. Even those skeptical of claims that the PBW is operationally imminent in the Soviet Union, acknowledge development of the device is just a matter of time.⁶⁰

A general description of the PBW category of directed-energy device is provided in the Fiscal Year 1979 Arms Control Impact Statements as follows:

The term particle beam weapon (PBW) refers to a range of concepts for devices using directed beams of charged or neutral particles at high energies as projectiles to inflict damage. The particles in question can be electrons, protons, heavy ions, or neutrons. Particle beams are produced either in circular or linear accelerators or combination of the two types. Moreover, particle beams can be stored in circular rings and released for specialized applications such as PBW. Particle beam weapons can also be designed using lasers; these would use highly intense, coherent light sources to develop a reduced density channel to enhance particle beam propagation.⁶¹

Particle-beam weapons of this description are subject to considerable variation depending upon the operational mission, the type of beam to be projected and the source of electrical power. However, based on current speculation, it is possible to describe some of the more important components of one variety of particle-beam weapon, the so-called "charged-particle beam" or "CPB."

The considerable power requirements necessary for the system would be generated by a component employing the use of either conventional or nuclear explosives to create a plasma. The plasma is then converted into electricity. Alternatively, banks of six to eight large jet engines might be employed to generate required electrical power. The electrical power generated by one of these means would then be stored and reemitted by a bank of capacitors and transformers to operate a beam accelerator. This unit, at least in the case of a charged-particle beam, would send waves of electrons (cyclotron eigenmodes) down its length where small groups of protons would be added. Finally, in initial test models, a hydrogen cooled "drift tube" could be employed to test propagation and the destructive power of the proton enriched waves created in the accelerator unit.⁶² An operational weapon would eliminate the drift tube, replacing it with an aiming-tracking mechanism for directing the beam. Such an aiming-tracking mechanism might use magnetic forces to direct the beam from the barrel of the accelerator to the selected target.

According to retired Major General George J. Keegan, former head of U.S. Air Force intelligence activities, the Soviet Union has conducted intensive and costly research for at least ten years to develop an operational CPB capable of directing a powerful beam of particles at enemy missile warheads and orbiting space vehicles.⁶³ The Soviet program is thought to be particularly concentrating on the charged form of particle-beam weapon, to wit, the "CPB."

As evidence of the alleged Soviet CPB program, General Keegan claims that a U.S. Air Force/TRW Block 647 defense support system early-warning satellite equipped with scanning radiation detectors and infrared sensors has detected evidence on seven occasions since November 1975 which would tend to indicate that charged-particle beam tests were conducted at a high security Soviet nuclear research facility 35 miles south of Semipalatinsk in the Republic of Kazakhstan. According to General Keegan, satellite sensors detected large amounts of gaseous hydrogen with traces of tritium in the upper atmosphere on these occasions. General Keegan and those who support his view contend that these substances would be expected biproducts of charged-particle beam testing. They argue that large amounts of liquid hydrogen are probably being used by the Soviets as the medium which cushions the controlled detonation of small nuclear bombs employed to create an electricity generating plasma. Moreover, the CPB proponents argue that considerable amounts of liquid hydrogen would be necessary to cryogenically cool the drift tubes used to test the beam. The tritium detected is thought to be a residue from the actual nuclear explosion of the generator itself.⁶⁴

General Keegan claims reconnaissance satellite photographs evidence a variety of impressive underground and surface facilities located inside a high security area within the Semipalatinsk test site itself. The observed facilities include one and possibly two steel spheres measuring approximately eighteen meters in diameter which have been sunk into granite caverns. Keegan believes these spheres are necessary to capture and store energy from nuclear explosions or pulse power generators. A large reinforced concrete building measuring 200 by 700 feet is thought to house associated support equipment.⁶⁵ As still further evidence of the alleged Soviet thrust to develop a CPB, General Keegan claims that the TRW early-warning satellite stationed over the Indian

Ocean monitored a test conducted in an area of natural dome formations at Azgir in Kazakhstan near the Caspian Sea in late 1976. He contends that the Azgir test site is under the direct control of the Soviet National Air Defense Force, the *PVO Strany*. He believes the *PVO Strany* is developing a new, far more powerful fusion-pulsed magnetohydrodynamic generator at this site to power the Soviet charged-particle beam itself.⁶⁶

Aviation Week and Space Technology writer Clarence Robinson, in support of the Keegan claims, asserts that the Soviets have already committed the equivalent of \$3 billion to their particle-beam weapons development program, \$500,000 of which is invested in the Semipalatinsk test site alone. Robinson argues intelligence information which suggests the CPB development program has now been placed under the direct control of the *PVO Strany*, the branch of the Soviet armed forces responsible for antimissile and antiaircraft defense, may indicate the Soviets are nearing the point of producing an operational weapons system.⁶⁷ Robinson recounts in considerable detail what he considers to be a most careful technical analysis by a group of young physicists assembled by General Keegan to independently gather and evaluate intelligence data on the possibility of a Soviet CPB technological breakthrough. The physicists are reported to have concurred with General Keegan that the Soviets might well have achieved the series of technological breakthroughs essential to attaining CPB operational capability in the near future.

Evidence possibly corroborating these claims has been independently released by Sweden's Defense Department. A report issued by Dr. Lars-Erik De Geer of the National Defense Research Institute in Stockholm, notes radioisotopes which could not be attributed to any known source were detected on five separate occasions, in late February, March, April, May and July of 1976, in the air over Sweden.⁶⁸ The report indicates that the unexpected and

unusual mixtures of isotopes were found to be Neptunium-239 and Molybdenum-99, usually biproducts of atmospheric fallout from nuclear explosions. The presence of these isotopes however, could not be attributed to any recorded nuclear or thermonuclear tests conducted during these general periods of time. Through checks with nuclear generating and research facilities, Dr. De Geer was further able to rule out the possibility of an accidental discharge from either government or commercial research or reactor sites. Dr. De Geer speculates that the isotopes could have been produced by tests using an explosive generator to develop power. The power produced would in turn be used to drive an accelerator producing the drive for a charged-particle beam.⁶⁹

Although much of the controversy concerning the particle-beam weapon has surrounded Soviet activities at the Azgir and Semipalatinsk sites, there is at least some evidence of United States interest in a similar type of directed-energy weapon. U.S. research and development into particle energy concepts has been underway in connection with a variety of applications for about three decades. Until recently, the principal use of the particle beams has been research surrounding fundamental physics.⁷⁰ Much of the research work has been carried out on an unclassified basis with extensive exchange of information between interested nations. Early applications of the particle-beam concept have been in food sterilization, polymerization of plastics, radiography, and cancer therapy.

The initial U.S. interest in using particle beams as weapons related devices developed during the 1950's when research focused on applying the concept as a means of breeding fissionable materials for military purposes.⁷¹ At least partly as a result of this research, it was suggested the particle-beam might itself be eventually developed into an efficient weapon. Perhaps the first U.S. program to directly pursue the particle-beam as a potential weapon was "Project Seesaw." Project Seesaw was funded through ARPA which, according to

one report, subsequently abandoned the PBW as impractical.⁷² Nevertheless, there are strong indications research and development have continued in a number of related areas.

As confirmed by the Fiscal Year 1979 Arms Control Impact Statements, the Defense Advanced Research Projects Agency and all three branches of the U.S. military services are exploring the potential of particle beam technology for a variety of applications. In a heavily censored report on the U.S. programs, the statement concerning directed-energy programs confirms a direct interest in the use of these devices in ballistic missile defense (BMD), as a satellite-borne antisatellite weapon, for shipborne antimissile systems and finally for various airborne and spaceborne applications. Funding for research and development programs for the three military services excluding ARPA for 1979 is estimated at \$12.7 million.⁷³

Probably the most costly and publicized research and development program is the Navy's "Chair Heritage" effort. The Navy sought \$7.1 million in Fiscal Year 1979 to continue work on the Chair Heritage and related PBW research.⁷⁴ The Chair Heritage project is reportedly engaged in continued exploratory development of beam weapons with an emphasis on accelerator research. A series of experiments using a scaled down advanced test accelerator unit will supposedly be completed by the Navy in August 1978 allowing a transition to an advanced developmental phase.⁷⁵ The details and potential mission of the Chair Heritage development device have not been made public. However, the 1979 Impact Statement suggests the Navy research program hopes to verify certain features of a system by approximately 1982.⁷⁶

Related U.S. Government sponsored research is reportedly aimed at perfecting an "auto-resonant accelerator." The auto-resonant accelerator when fully developed would have the capability of generating low-cost, extremely

intense beams of high-energy heavy particles. Austin Research Associates has been funded to research means of directing energy the equivalent of pounds of TNT at the speed of light to remotely located blast targets.⁷⁷ While these and other known U.S. Government programs are most probably still in the feasibility study and exploratory research stages, they nevertheless suggest a significant commitment to the eventual development of a directed-energy weapon of at least equal potential to the high-energy laser.

2. PBW Characteristics and Capabilities

The particle-beam weapon, whether it uses a directed stream of electrons, protons, heavy ions or neutrons, will probably exhibit many of the same capabilities and characteristics of the proposed high-energy lasers. Like the HEL, the PBW when developed will transmit force to its target at the speed of light. A PBW, however, transfers its energy at essentially 100 percent efficiency.⁷⁸ A PBW could be repeatedly redirected and refired at the same or varying targets within a short span of time. It is likely that this weapon would be utilized in a semiautomatic or fully automatic mode employing the use of sophisticated computers and tracking instruments to identify, prioritize, aim and fire at potential targets. Accordingly, like its laser counterpart, the particle-beam weapon when deployed may well be programmed so as to reduce or eliminate human decision-making and provide for a minimal time response against all appropriate targets once the initial authorization to execute operations is given. If employed in a defensive mode, even the initial order to fire may be eliminated allowing the programmed PBW to respond to perceived hostile acts directed against the possessor participant or its resources.

The particle-beam weapon's destructive force can be distinguished from that of the laser in a number of particulars. The HEL weapon's

destructive force can be substantially reduced or even eliminated altogether when its beam is transmitted through the atmosphere because of physical, environmental, meteorological or other conditions. However, attenuation, beam dispersion, refraction, reflection and other adverse physical phenomena do not present a problem for PBW pulses fired into or out of the atmosphere. The particle-beam weapon may be employed regardless of cloud cover, fog, rain, snow, suspended particulate matter in the air or any of the other influences which tend to diminish the impact of the high-energy laser beam.⁷⁹ Theorists speculate that whereas cloud cover, fog, snow, rain, reflective surfaces and artificial clouds of metallic particles may serve to protect targets against laser attack, the PBW could penetrate almost any known material or configuration causing intense destruction.⁸⁰

Since high-energy lasers have been fired under laboratory and field conditions, it is possible to assess their destructive effects on particular targets. Unclassified information is not available however with regard to any possible PBW tests. Any appraisal of this weapon's effect upon various types of targets, personnel or materiel, is largely speculative. However, the limited literature on the subject suggests target destruction may occur through blast effects or shock waves created in the target.⁸¹

3. Limitations and Countermeasures

While the PBW has fewer drawbacks than the high-energy laser, it is nevertheless subject to limitations and defensive countermeasures. Assuming the various developmental and physical barriers to constructing an operational beam weapon can be successfully overcome, skeptics still point to the substantial difficulties in scaling the device down to a size and weight which would facilitate a cost-effective, mobile weapon. The requisite capacitor banks,

transformers and power generation facilities even with today's relatively advanced technology tend to be massive.⁸² If the PBW is to have more than a ground-based defense mission, relatively mobile systems will have to be designed. Since the PBW, like the HEL, is essentially a line-of-sight weapon, such mobility would be critical in offensive military missions.

A second technical problem which will have to be overcome is the propensity of the particle-beam to be deflected by the earth's magnetic field.⁸³ Since the extent of this effect may be complex and difficult to predict, weapons developers must pursue systems which either compensate for or are not adversely affected by these magnetic forces. Again there is some reason to believe that eventually, technological barriers in this area can be overcome.

Skeptics of the particle-beam weapon argue that those who contend the device would be useful in antiballistic missile and air defense systems ignore the complexities of the particular military missions. Two critics of the claims regarding alleged Soviet development of an operational CPB assert that the limited resolution capacity of conventional tracking radars added to beam bending caused by the earth's magnetic field makes using this type of device for air or missile defense "like trying to shoot at a bullet coming toward you on a foggy day while your gun hand is shaking and the wind is blowing."⁸⁴ Authority Clarence Robinson counters this argument by noting that it may be possible in missile defense to use a shotgun-like, rapid beam firing sequence aimed at relatively predictable ballistic missile transit lanes to interdict incoming warheads.⁸⁵

It appears at least some defensive countermeasures may be available against the particle-beam weapons. Again the use of decoys may make targeting far more difficult by greatly increasing the number of potential targets and complexity of range-velocity problems. Alternatively, defenders may be able to use

"deflectors extended from potential targets" complicating or at least slowing the actual task of target destruction.⁸⁶ Another countermeasure showing some potential is the use of nuclear explosives to artificially ionize the atmosphere for the purpose of deflecting the attacking particle-beam. Even if beam particles are neutral, the ionized and dispersed gas from the top of the atmosphere could be blown up in the path of the beam by the force of the nuclear device.⁸⁷

4. Strategic Implications

Despite major technical problems which most probably are still to be overcome, it would be naïve to rule out the possibility of PBW development. Once effectively developed, the particle-beam weapon could prove at least as effective against important strategic and tactical targets as the high-energy laser while being hampered by fewer limitations. As in the case of the high-energy laser, elimination or the threat of elimination of strategic delivery systems can not help but influence participant expectations and perceptions. A participant in exclusive possession of an operational PBW would enjoy a quantum increase in its bases of power. Again, the entire fabric of the existing strategic balance between the superpowers could be severely strained by the advent of such a weapons system.

The potential PBW probably shows even greater promise as an efficient weapon than the laser. The fact it can operate in terrestrial theaters or in space with equal destructive effect obviously makes it attractive to military planners searching for multipurpose, multi-theater weapons. The weapon's reliability may be relatively constant through the entire earth-space arena; whether in near space, terrestrial zones or a combination of the two. Once

a mobile weapons system can be achieved, even the line-of-sight limitation of the PBW will have been overcome allowing virtually unlimited mission capability. Perhaps even more than the HEL, the PBW could prove a precise and controllable weapon. These features represent two clear advantages over most conventional devices and existing weapons of mass destruction.

Noting the import of the particle-beam weapon to U.S. defense policy, one aviation industry publication observed:

Senior U.S. scientists and engineers believe that this nation is on the verge of a heated debate over the strategic implications of charged-particle beam development in the Soviet Union and the U.S.

'That debate is just getting under way and it is likely to rival the "fortress America Great Defense Debate" in 1952 involving Taft (Sen. Robert A. Taft), the B-36 bomber and strategic defense politics,' one U.S. official said.⁸⁸

One of the more dramatic perceptions of the impact of the alleged Soviet charged-particle beam upon the strategic balance between the two superpowers is articulated in an *Aviation Week and Space Technology* editorial by Robert Hotz:

There also is an element in the Pentagon that can visualize the eventual Soviet deployment of the directed-energy beam weapon as the end game of an intricate chess exercise that began with the 1972 negotiation of the anti-ballistic missile treaty, which effectively stopped not only U.S. deployment of an anti-ICBM system but also most of its significant ongoing research and development. The hypothesis for this chess game, which ends in the early 1980's with the triumphant Soviet shout of 'check and mate,' involves the U.S. finding its strategic deterrent ballistic missile force stripped of any defensive system, with the Soviets using their anti-ICBM directed-energy beam weapon to negate any U.S. retaliation and a strong civil defense shield to minimize damage from the few warheads that might penetrate.⁸⁹

While this foreboding perspective is perhaps recounted for maximum persuasive impact on Hotz's readers, it nevertheless illustrates at least perceptions of strategic imbalance and instability which could result from the deployment

of a particle-beam weapon. It may well be that the perceptions of the body politic and ruling elites in participant states as to their state's relative security are at least as important as the actual balance of strategic power itself.⁹⁰

II

ASSUMPTIONS, ISSUES AND METHODOLOGY

Some experts were of the opinion that, because the effects of potential future weapons could have important humanitarian implications, it was necessary to keep a close watch in order to develop any prohibitions or limitations that might seem necessary before the weapon in question had become widely accepted. (sic)

Conference of Government Experts on the
Use of Certain Conventional Weapons 91
(Lucerne, Switzerland, 1974)

A. Fundamental Assumptions

The advent of first generation directed-energy weapons now appears irrevocably imminent. With destructive force of a character and mode not previously experienced, the introduction of directed-energy weapons is far more than merely another notch upward in the arms race between the superpowers. So unique are their qualities and so far reaching their impact upon participant state strategies in the earth-space arena, that it is crucial to subject these new instruments of warfare to thorough examination. It seems particularly important that this examination be accomplished on a prospective basis rather than after costly and politically entrenched decisions are made regarding production, deployment and use of these new weapons systems.

In pursuing an examination of directed-energy weapons, it is important to identify certain fundamental assumptions, some of which may be retained

while others are disgarded to facilitate an analysis of maximum objectivity. Initially, it is assumed that the world generally exists in a state which the prominent international legal scholar Professor Myres McDougal refers to as a "minimum public order" and from which it is disadvantageous to deviate except in so far as such departure is in pursuit of an improved or optimum world public order system. Professors McDougal, Lasswell and Vlasic perceive the minimum public order in the earth-space arena in these terms:

The fundamental constitutional principle of minimum order, so painfully and tentatively established for the earth arena in recent times by the United Nations Charter and other authoritative expressions, would thus appear no less indispensable, in all its detailed nuances, in man's newer, expanding earth-space arena. Most comprehensively stated, this principle of minimum order embraces, it may be recalled, both a negative policy of minimizing coercive changes and a positive policy of promoting the shaping and sharing of values by persuasion. In its negative formulations, the principle seeks to prohibit any unilateral use of intense coercion by one community against another as a deliberate instrument of special interest. In its positive formulation, the principle seeks to promote that stability in expectations of freedom from arbitrary coercions which is indispensable to the fullest cooperative activity in the production and distribution of values. For the better achievement of this overriding objective of minimum order, whichever way it may be formulated, the general community seeks to establish further, both that major coercion is made its monopoly for inclusive decision and that, even so controlled, major coercion is but seldom applied, and then only in the most urgent common interest.⁹²

Underlying the legal policy issues and claims analysis which follow is the assumption that the maintenance of minimum public order is a desirable threshold objective for participants in the earth-space arena. It is further assumed participants will pursue enhancement of exclusive, and occasionally, inclusive, interests through institutions which reflect their expectations and perceptions. Exclusive interests are taken to include the participant's interest in protecting its security, health, well-being and other values from external attack as well as its desire to assert unilateral competence over at least its activities in the earth-space arena.⁹³ Inclusive interests

are considered to encompass the objective of minimization of unauthorized violence or coercion between or among participants. Inclusive interests also include the enhancement of shared competence over activities in the earth-space arena as well as the promotion of change through peaceful, persuasive mechanisms.⁹⁴

An assumption is also made that legal policy issues should address, and the claims analysis be considered in the context of, what has been termed the "earth-space arena." The earth-space arena is taken to include the three terrestrial theaters of participant military activity: the land, the oceans and the atmosphere. Additionally, this arena of interaction incorporates a fourth theater referred to as near space. In certain instances, the arena may reach out to even more distant areas of outer space. However, it appears the most immediate significant encounters will be experienced in the terrestrial and near space theaters. Implicit in this probable eventuality is that the interrelationship between near space and the terrestrial theaters is often of great import. This import stems from the fact that many of the directed-energy weapons under research and development are being designed for comprehensive use throughout this expanded arena. Moreover, some of these devices may be particularly deployed in one theater, for example near space, for expected use against targets in another theater, perhaps surface land facilities. Participants appear to be seeking instruments and countermeasures which will function from, to and within all four theaters in the expanded earth-space arena.

While these assumptions are acknowledged at the outset, at least one prejudice must be exposed and avoided in a juridical analysis of this type. While it might be convenient and indeed expedient to assume the destructive potential and unique capabilities of the innovative directed-energy weapon are inconsistent with the maintenance of minimum world public order, it would be a myopic analysis which proceeded on this premise. The directed-energy device must

be viewed in the total context of controlling participant strategies and relevant experiences in the military, ideological and diplomatic spheres. The analysis must consider existing military resources available to major state participants. In analyzing this weapon and its implications to the maintenance of minimum order, it is important to note the impact existing arsenals have upon the earth-space arena while speculating as to the effect of a basic change brought on by the addition of any new coercive device.

In short, by suppressing the commonly held assumption that innovative weapons of great potential force necessarily impose negative effects upon the minimum order system, the directed-energy device may be considered not only for its destructive capabilities, but also in light of any positive influence it might have in promoting what Professor McDougal refers to as "stability in expectations of freedom from arbitrary coercions."⁹⁵ While change, particularly in a form which brings with it elevated potential for destruction of values, may imply undesirable instability in the minimum order system, such change must also be recognized as affording new opportunities to those perceptive enough to grasp them.

B. The Legal Policy Issues

With this understanding of the operative and inoperative assumptions inherent to this analysis, it is possible to consider a set of legal policy issues. The threshold question is the extent to which the comprehensive international legal regime applied in the earth-space arena functions to prohibit or limit participant research, development, testing, production, deployment and use of directed-energy weapons. Closely linked to this consideration is the examination of the extent to which the contemporary law of strategic arms control functions to prohibit or limit these same participant activities

vis-à-vis directed-energy weapons.⁹⁶

To the extent an examination of these issues suggests a reliable, comprehensive and credible régime supportive of the minimum world public order system and oriented toward an optimum world public order system, it might be unnecessary to offer further analysis. However, to the extent the regime may be deficient, a juridical analysis must query to what extent the international humanitarian law of armed conflict applies to prohibit or limit the research, development, testing, production, deployment and use of these new weapons. Having considered the applicable prohibitions against and limitations on directed-energy weapons provided by these bases of international law, it is important to evaluate the participant strategies or policies which should be maintained, developed or pursued to enhance the objective of an optimum world public order system. What institutional changes are suggested as a possible means either to restore equilibrium in the minimum world public order system or for the purpose of advancing toward an optimum world order system embracing extensive value sharing and minimum unauthorized coercion?

C. Methodology

A consideration and proposed resolution of the various legal policy issues can effectively be pursued through an evaluation of the institutional bases for participant claims and counterclaims. With respect to an examination of each of the issues, it is important to identify the key participants, to understand their respective interests in the issue and appraise their positions to the extent they may be known. Unfortunately, to date participant states engaged in research and development have generally avoided taking official positions concerning these weapons. Accordingly, analysis of the respective participant positions, even those of the key superpowers engaged in the principal research and

development, will have to depend largely upon an evaluation of analogous circumstances and potentially applicable doctrine. Nevertheless, at least some preliminary participant interaction seems to be focused on the problems posed by directed-energy weaponry and is available as a basis for claims analysis.

For purposes of analysis, claims relating to the permissibility and impermissibility of new weapons may be divided into two broad categories. The first of these categories includes claims supporting the prohibition *per se* of specific weapons or categories of weapons systems. However, it is not sufficient to merely acknowledge that a claim establishes a prohibition. It is important to comprehend the parameters of the prohibition itself. Whereas some claims may propose to prohibit all facets of participant involvement in a weapons system, others may be prohibitions specifically addressing some particular phase of the weapon's evolution or application, to wit; its research, development, testing, production, stockpiling, deployment or actual use in circumstances of armed conflict.

A second major category of claims and counterclaims includes those which bear on weapons limitation. This category considers whether participants have attempted to create restrictions on their actions within one or more phases in the weapon's evolution or application. Although a limitation may be keyed to many types of criteria, some of the more typical include controls on destructive capabilities and characteristics; numbers of weapons produced, stockpiled or deployed; geopolitical theaters of deployment or use; participants authorized to be in possession of weapons systems; objectives of lawful attack; how a weapon is used against particular targets; and circumstances authorizing a weapon's use. While the absence of empirical evidence in the field of directed-energy weapons makes analysis of this second category of claims difficult, at least a preliminary

evaluation may proceed based upon applicable customary and conventional international law in addition to possible analogous experience.

Having identified the claimants, their respective interests and the broad weapons control categories of prohibition and limitation, it may be useful to qualitatively appraise the claims and counterclaims. Do these claims incorporate comprehensive or limited interests of the participants? Are the claims asserted through explicit or implicit means? Claims which are asserted through explicit means are those communicated by some use or transmission of language. Claims asserted implicitly are manifested through participant actions. Yet another qualitative feature is whether the claims and counterclaims are oriented to the participant's exclusive or inclusive interests.⁹⁷

Finally, a thorough methodological approach must evaluate the principal claims and counterclaims through a series of identifiable, fixed criteria. For purposes of this analysis, claims founded on particular institutional bases will be tested for their applicability to the factual circumstances surrounding directed-energy weapons. The assumption implicit in this criterion is that the stronger the apparent logical connection between the legal basis and the factual context, the more substantial the claim or counterclaim. A second evaluative criterion will query whether the critical base values or interests of the key participants are served. This criterion assumes that the greater the number of critical base values supported by a particular institution, the more persuasive the claim.

Claims and counterclaims may also be evaluated in terms of available supportive sanctions. A third important criterion surveys the availability of credible supportive sanctions. The greater the number of available sanctions and the stronger their individual credibility among participants, the more persuasive the claims which depend upon such mechanisms for their enforcement. An intricately related fourth criterion examines the reliability of the sanctions

themselves.

Claims and counterclaims may also be evaluated in terms of their potential for achieving consensus participant support. Claims supported by the greatest number of participant interests, whether inclusive, exclusive or both, will typically prevail over those which are supported by one or two isolated, weak interests. This last criterion may be particularly useful for purposes of comparing the various claims and counterclaims relating to the permissibility or impermissibility of directed-energy weapons.

It is beyond the scope of this study to exhaustively consider all facets of the legal policy issues. However, the need for a prospective analysis of directed-energy weapons demands a survey of principal participant claims and counterclaims. Potential claims and counterclaims viewed as a whole offer at least a preliminary perspective of the impact of the directed-energy weapon on the minimum world public order. They also afford a basis from which it is possible to extrapolate what institutional modifications may be possible and desirable for the purpose of pursuing the optimum world public order system.

III

CONTROL OF DIRECTED-ENERGY WEAPONS THROUGH THE COMPREHENSIVE INTERNATIONAL LAW

The conclusion to which we must inevitably come, therefore, is that outer space, like most of the other areas and resources open to man, will continue to be used, in comprehensive earth-space value processes, for many varying activities, both military and nonmilitary, and scientific and nonscientific. The only limitations upon the scope and nature of these activities, apart from those which states find necessary to the maintenance of minimum and promotion of optimum order, will be those determined by the degree of technological progress and scientific knowledge about space at the disposal of the most advanced user.

McDougal, Lasswell, and Vlasic⁹⁸

In analyzing the extent of existing prohibitions and limitations on directed-energy weapons, it is logical to begin by surveying the comprehensive international law specifically applicable to the earth-space arena. In the slightly more than two decades during which man has been active in this expanded arena, he has undertaken to create a substantial legal regime based upon specially tailored general principles; a brief experience with participant custom, usage and practice; and a modest but growing number of formal international conventions. To the extent that this evolving body of law has sought to impose explicit prohibitions or limitations on weapons systems in the earth-space arena, it is germane to the basic question of the legality of

directed-energy weapons. A survey of the comprehensive international legal regime applicable to the earth-space arena reveals three sets of institutional bases which may be considered as supportive of claims bearing on the prohibition or limitation of directed-energy weapons.

A. General Principles and the Evolving Customary Law

The first set of institutional bases subject to examination includes a composite of general principles, practice, usage and a small body of customary law specifically applicable to the earth-space arena. These various institutions considered separately are often of limited apparent value with respect to controlling participant actions. However, taken together they serve to constrain or guide at least some types of conduct. More important, they have served as guidelines for the establishment of the comprehensive conventional regime created by the 1967 Outer Space Treaty.⁹⁹ An examination of these institutions affords a better understanding of the actions, expectations and perspectives of the key participants in the earth-space arena. In particular, it assists in understanding important constructions and interpretations of the Treaty regime itself.

The genesis of weapon's control in this body of international law can be traced back to 1957 when President Eisenhower in his State of the Union Message noted inherent dangers in the development of outer space missiles and satellites.¹⁰⁰ President Eisenhower expressed American interest in entering into "any reliable agreement which would . . . mutually control the outer space missile and satellite development."¹⁰¹ In connection with the Eisenhower message, the United States submitted a proposal to the United Nations General Assembly offering a plan to bring certain activities such as the testing of

satellites and missiles under international control and inspection.¹⁰² President Eisenhower's message and its concomitant arms control proposal may have represented the first disarmament initiative applicable to the expanded earth-space arena.

In the months that followed this first American initiative, there arose an increasing international awareness and interest in the problems of arms control and disarmament in the expanded arena. In August of the same year, a Western proposal for partial disarmament jointly authored by Canada, France, the United Kingdom and the United States was submitted to the Sub-committee of the Disarmament Commission. The proposal, like the Eisenhower initiative, emphasized the need for an inspection and verification mechanism which would ensure that objects sent through space were exclusively for peaceful and scientific purposes.¹⁰³ The Soviets promptly rejected the Western proposal and shortly after, on October 4, 1957, startled the international community with the first successful launching of an artificial earth satellite, Sputnik I.

Following the orbiting of Sputnik I, U.S. Ambassador to the U.N., Henry Cabot Lodge, reiterated the Western partial disarmament proposal. The General Assembly, acting both in response to Ambassador Lodge's call for a U.N. technical committee to address the key issues of the peaceful and scientific use of outer space as well as through its own desire to prevent the arms race from spreading to space, adopted Resolution 1148 (XII).¹⁰⁴ The resolution, adopted over the opposition of the Soviet bloc socialist states, incorporated the Western concept of calling for a study of an inspection system designed to ensure that all objects launched into space would be exclusively for peaceful and scientific purposes. Of particular import was key language in the resolution providing one of the earlier applications of the words "weapons of mass destruction," in connection with a proposal for international disarmament or arms

control in the expanded arena.¹⁰⁵

As a result of these early developments, attention was focused on international arms control in the expanded arena both in bilateral dialogue between the superpowers and through multilateral interaction within the context of the United Nations General Assembly or subsidiary U.N. committees or agencies. President Eisenhower and Soviet Premier Bulganin entered into an exchange of correspondence in which each decision-maker asserted participant claims bearing on the scope and means of international arms control. At issue in the bilateral dialogue was the matter of linkage which the Soviets argued should exist between the American proposal for peaceful purposes and uses of outer space and the traditional socialist negotiating demands for liquidation of overseas military bases by the Western allies.¹⁰⁶ The Western allies countered Soviet demands for linkage by proposing referral of the overall issue to a United Nations *ad hoc* committee.

In November of 1958, the United States and nineteen other countries co-sponsored a draft resolution calling for the creation of the *ad hoc* committee. The Soviets responded with a substantially revised draft resolution which eliminated their previous demand for an end to all foreign military bases. The revised Soviet proposal called for the establishment of a U.N. committee for cooperation in the study of cosmic space.¹⁰⁷ On December 13, 1958, the General Assembly despite Soviet block opposition, adopted Resolution 1348 (XIII)¹⁰⁸ establishing an eighteen member *Ad Hoc* Committee on the Peaceful Uses of Outer Space. The resolution sought to establish the applicability of both the United Nations Charter and the Statute of the International Court of Justice with respect to activities in outer space. Once again it invoked language referencing the need to pursue "peaceful purposes" and "peaceful uses" in the outer space arena.

The resultant *ad hoc* committee commenced a review of possible alternative legal regimes which might be applied to encourage the "peaceful" conduct of space operations. However, the committee was hampered by the lack of Soviet bloc participation and on December 10, 1959, Ambassador Lodge submitted a draft resolution recommending U.N. efforts to achieve international cooperation and the peaceful uses of outer space not be further delayed because of the impasse on disarmament which involved among other things the continuing dispute over the linkage issue.¹⁰⁹ Within forty-eight hours, the General Assembly had unanimously adopted Resolution 1472 (XIV)¹¹⁰ recognizing "the common interest of mankind ... in furthering the peaceful use of outer space" and creating a permanent twenty-four member Committee on the Peaceful Uses of Outer Space (COPUOS).

Although the unanimous adoption of Resolution 1472 (XIV) signaled the first major agreement among the principal space resource participants regarding the general principles upon which a comprehensive legal regime could be based, disagreement on both the linkage issue and the composition of the committee itself prevented further immediate progress. The Western allies submitted a paper on March 16, 1960 to the Committee on Disarmament calling for joint studies "to assure compliance with an agreement that no nation shall place into orbit or station in outer space weapons of mass destruction."¹¹¹ A few months later, on June 27, 1960, the United States proposed to the Ten-Nation Committee on Disarmament that "the placing into orbit or stationing in outer space of vehicles carrying weapons capable of mass destruction shall be prohibited."¹¹² This was followed by President Eisenhower's farewell address to the U.N. General Assembly September 22, 1960 in which he detailed a four point disarmament proposal known as the "Eisenhower Doctrine." In proposing a ban on weapons, he reiterated disarmament principles established in the Antarctic Treaty and

proposed they be applied to an outer space and celestial body regime.¹¹³

President Kennedy in an address to the General Assembly in September 1961, reaffirmed the basic principles of the "Eisenhower Doctrine" referencing the language "peaceful uses" of space and a prohibition of "weapons of mass destruction." With the Soviet return to COPUOS in 1961, the General Assembly adopted Resolution 1721 (XVI)¹¹⁴ which commended a number of general legal principles to states with regard to the exploration and use of outer space. The resolution reiterated the claim that international law including the U.N. Charter applied to outer space and celestial bodies. It further proclaimed that outer space was to be considered free for exploration and use by all states in accordance with international law and would not be considered subject to national appropriation. In effect, the vast majority of the world community speaking through the General Assembly had attempted to prescribe a regime of *res communis omnium* vice *res nullius* for the environs of both near space and outer space.

The bilateral superpower dialogue regarding possible arms control in the expanded earth-space arena continued in 1962 with the Soviets proffering a plan in March of that year which among other things called for a prohibition in the first stage of "orbiting or placing in outer space special devices capable of carrying mass destruction weapons."¹¹⁵ As in previous references to the term "weapons of mass destruction," it was unclear whether the term applied to innovative weaponry or merely existing systems.

By May of 1962, a COPUOS meeting in Geneva was constructively moving toward a more fundamental statement of the evolving international space regime. Outlining U.S. policy three days prior to the meeting of the Legal Sub-Committee, Secretary of State Dean Rusk indicated that one of three principal U.S. policy objectives in developing an international regime

in space was the prohibition of placing weapons of mass destruction in orbit.¹¹⁶ Secretary Rusk may have provided at least some clue as to the U.S. interpretation of "weapons of mass destruction" with respect to innovative weaponry when he referred to such things as "orbiting or stationing vehicles carrying nuclear weapons, military bases on the moon and the military use of weather control."¹¹⁷ Although this reference is less than precise, it provides one of the earlier participant applications of the key terminology to possible types of weaponry or military activity in the expanded arena.

The continuing but somewhat indecisive political posturing that occurred during the Legal Sub-Committee meeting in Geneva ultimately resulted in the adoption of U.N. General Assembly Resolution 1802 (XVII).¹¹⁸ The resolution represented little real progress and was essentially one more generalized statement of goals and aspirations of the international community for outer space. When the Legal Sub-Committee convened in spring of 1963, it renewed efforts to develop a substantive general enumeration of principles applicable to outer space. For the first time, major exclusive and inclusive interests of the participants were coming into alignment and the conditions for consensus were becoming apparent.

Each of the superpowers had completed testing at least its first generation ICBM's and could claim possession of a crude, but nevertheless operational, ballistic missile deterrence force. Each superpower had conducted related nuclear and thermonuclear tests oriented toward the development of operational warheads for the new ballistic missile force. Moreover, the problem of weapons verification was somewhat diminished as an essential Western issue by the development of reconnaissance and space-tracking facilities.¹¹⁹ By using these facilities, it was possible to evaluate the operational capabilities, if not intentions, of the opponent participant. These developments, in connection with great pressures from the international community to cease the

environmentally dangerous nuclear testing, resulted in the Nuclear Test Ban Treaty being signed in Moscow August 5, 1963.¹²⁰

In this spirit and largely because the superpowers had concluded that orbiting nuclear weapons were less efficient than existent ballistic missile forces,¹²¹ Foreign Minister Gromyko announced to the General Assembly on September 19, 1963, that the Soviet Union was prepared to conclude an agreement banning the orbiting of objects carrying nuclear weapons. U.S. Ambassador to the United Nations Adlai Stevenson responded that the U.S. had no intention of orbiting weapons of mass destruction, installing them on celestial bodies or stationing them in outer space. By October of 1963, seventeen nations of the eighteen nation U.N. Disarmament Committee presented Resolution 1884 (XVIII)¹²² to the U.N. Political Committee calling for a ban on orbiting nuclear weapons and other weapons of mass destruction. The resolution was unanimously approved October 16, 1963 and called on participants to refrain from placing in orbit around the earth, delivering to celestial bodies or stationing in outer space in any other manner, weapons of mass destruction.

While Resolution 1884 (XVIII) represented the most definitive statement yet regarding weapons control in the expanded arena, the General Assembly again failed to address the exact parameters of the term "weapons of mass destruction" with respect to innovative weapons in the earth-space arena. Moreover, neither the tacit bilateral Soviet-American agreement nor the multilateral U.N. Disarmament Committee or General Assembly actions sought to impose concrete controls on any phase or aspect of weaponry beyond actual deployment of the ambiguous weapons categories. No serious effort was made to ban or limit research, development or even testing of such weapons systems. These two major oversights were a harbinger of the ambiguities and troublesome voids which have largely set the stage for projection of the current superpower arms race into the expanded earth-space arena.

The Eighteenth General Assembly took one further action in 1963 generally acknowledged to be a cornerstone of the comprehensive international law in the earth-space arena. After additional debate, the Assembly unanimously adopted U.N. Resolution 1962 (XVIII) on December 13, 1963 entitled "The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space."¹²³ The Declaration represented the culmination of several years efforts to achieve a consensus on a comprehensive set of general principles applicable to space. This "magna carta" of the international legal regime for space offered nine relatively broad principles.

Although none of the nine principles specifically addressed the issue of coercion or authorized weapon systems in space, paragraph 1 provided "The exploration and use of outer space shall be carried out for the benefit and in the interests of all mankind."¹²⁴ In the second pertinent provision, the Assembly declared in paragraph 4, "The activities of States in the exploration and use of outer space shall be carried on in accordance with international law, including the Charter of the United Nations."¹²⁵ These two provisions, coupled with the rather broad language of Resolution 1884 (XVIII), were to become cornerstones of the 1967 Outer Space Treaty and accordingly are of some significance as a basis for potential claims prohibiting or limiting directed-energy weapons.

While the precise juridical impact of this myriad of United Nations resolutions, multilateral declarations and bilateral exchanges may be less than clear, a limited body of international customary law seems to have surfaced through the claims-counterclaims process. In referring to the earlier unanimous adoption of General Assembly Resolution 1721 (XVI), former Deputy Legal Advisor for the U.S. Department of State Leonard Meek observed "When the

General Assembly resolution proclaims principles of international law - - as resolution 1721 has done - - and was adopted unanimously, it represents the law generally accepted in the international community."¹²⁶

While Mr. Meeker's observation may represent something of an oversimplification if not an overstatement, it is probably accurate to say that the 1963 Declaration of Principles, in conjunction with the other multilateral and bilateral initiatives, constitutes an international consensus among space resource states as to at least two fundamental concepts. First, that the general body of international law including the U.N. Charter is as applicable to the expanded earth-space arena as to the traditional terrestrial theaters. Secondly, that in consequence of continuously expressed, although perhaps ethereal references to peaceful purposes, peaceful uses and banning nuclear or other weapons of mass destruction from space, participants harbor some notion that their interests, both exclusive and inclusive, can be enhanced through control of coercive devices in this expanded arena.

It is important in examining these early general principles, to observe that while they may aid in the preliminary formulation of a customary international law applicable to the expanded earth-space arena, as institutions they do not offer a viable basis for either the prohibition or limitation of directed-energy weaponry. These general principles are devoid of either reliable or credible sanctioning mechanisms. The mechanisms which are available depend upon the unreliable interest of the individual participant in projecting an image as a "responsible member" of the world community. Even the limited effect of this sanction is constrained by the inherent ambiguities of the general principles themselves. The fact participants from 1957 through the evolution of the more refined Declaration of 1963 consistently avoided concrete definitions within the context of the expanded arena with respect to terminology such

as "peaceful purposes" and "weapons of mass destruction" only served to encourage exclusive, self-serving interpretations. Such interpretations could hardly be construed as consistent with the establishment of any responsible international arms prohibition or limitation mechanism.

Claims based upon these concepts may be further blunted by the fact that if read broadly, these principles are not always aligned with participant interests. It is true that superpower participants through their tacit agreement eventually moved to prohibit orbital deployment of nuclear weapons and other weapons of mass destruction. Yet this agreement was achieved only after it appeared these systems were relatively inefficient. The relatively more efficient nuclear armed ICBM forces in conjunction with the development of technological means which allowed participants to freely reconnoiter and verify the activities of their adversaries, were the true foundations for weapons control in space. Hence, the general principles as manifested in these early resolutions and initiatives can only be safely considered within the relatively narrow context in which they were drafted. One need only consider the fact that no participant seriously contended that these principles would act to prohibit or even limit the transit of intercontinental ballistic missiles through near space. Nor were these principles interpreted so broadly as to limit the orbiting of early military reconnaissance and sensing satellite systems such as SAMOS and MIDAS. In short, the ambiguity and the absence of credible sanctioning mechanisms eliminates these principles as a persuasive institutional basis upon which claims to arms control may be founded. These concepts are poorly suited to the demanding task of controlling innovative weaponry in the earth-space arena.

B. Conventional Regime: The Outer Space Treaty

On the same day that the Eighteenth General Assembly unanimously accepted the Declaration of Legal Principles, it adopted Resolution 1963 (XVIII)¹²⁷ requesting COPUOS continue its study of legal problems which arise in connection with the exploration and use of outer space. The resolution further recommended the development of an international agreement establishing legal principles to govern activities in the arena. In response, the Legal Sub-Committee met again during October of 1964 for the purpose of developing a treaty to provide for the assistance and return of astronauts. Additionally, the Legal Sub-Committee turned its attention to a proposed agreement on tort liability resulting from space exploration and use.¹²⁸ Although major space resource states regarded these agreements as progress toward a comprehensive legal regime for space, it was clear the two instruments did not offer the pervasive treaty requested in Resolution 1963 (XVIII).

During the Twentieth Session of the General Assembly, U.S. United Nations Ambassador Arthur Goldberg proposed consideration of a comprehensive treaty on the exploration of celestial bodies. Goldberg subsequently advised the Political Committee that the United States intended to present such a proposal. His proposals were essentially incorporated by the General Assembly into Resolution 2130 (XX) which received unanimous approval in December of 1965.¹²⁹ In May of 1966, President Johnson announced that the United States would seek a treaty through the United Nations to lay down "rules and procedures for the exploration of celestial bodies."¹³⁰ In listing "essential elements" for such a treaty, the President again invoked language similar to that previously adopted in the general principles of Resolution 1884 (XVIII) banning weapons of mass destruction for certain areas of space. He proposed the treaty

provide prohibitions against stationing of mass destruction weapons on celestial bodies. The President also proposed such prohibitions extend to weapon tests and military maneuvers on such bodies.

COPUOS undertook consideration of the Johnson treaty proposal the same month and was soon in receipt of a Soviet counterproposal suggesting the 1963 Declaration of Legal Principles be upgraded to the status of an international agreement.¹³¹ On June 16, 1966, both the United States and the Soviet Union submitted draft treaties. Negotiations among the major space resource states followed in a surprisingly constructive atmosphere. The U.S. draft treaty offered a legal regime which covered only celestial bodies. Two provisions in the American draft specifically related to arms control. Article 8 again invoked the familiar language regarding prohibition of weapons of mass destruction stating, "In accordance with the sense of General Assembly Resolution 1884 (XVIII), adopted by acclamation on October 17, 1963, no State shall station on or near a celestial body any nuclear weapons or other weapons of mass destruction."¹³² Article 9 of the U.S. treaty proposal reiterated the general principle of peaceful purposes and sought to limit certain specific military activity on celestial bodies:

Celestial bodies shall be used for peaceful purposes only. All States undertake to refrain from conducting on celestial bodies any activities such as the establishment of military fortifications, the carrying out of military maneuvers, or the testing of any type of weapons. The use of military personnel, facilities or equipment for scientific research or for any other peaceful purposes shall not be prohibited. 133

The Soviet draft treaty, in contrast to the American version, included the entire space arena. The pertinent arms control provisions of the Soviet draft were contained in Article IV:

The Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or other weapons of mass destruction and not to station such weapons on celestial bodies or otherwise to station them in outer space. The moon and other celestial bodies shall be used exclusively for peaceful purposes by all Parties to the Treaty. The establishment of military bases and installations, the testing of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden.¹³⁴

Again the key principles of the use of space for exclusively peaceful purposes and the prohibition of nuclear or any other weapons of mass destruction play a dominant role in the text. Since the U.S. had previously supported Resolution 1884 (XVIII) which purported to prohibit nuclear or other weapons of mass destruction from various other areas in space, no significant objections were raised to the Soviet plan for a relatively pervasive regime not limited to celestial bodies. On July 20, 1966, the U.S. accepted the Soviet proposition that the scope of the treaty negotiations consider the entire outer space arena.¹³⁵

Remaining differences between the states participating in Treaty negotiations were relatively minor. Private consultations continued during the General Assembly session and by December a consensus draft had been achieved. On December 19, 1966, the General Assembly approved the proposed draft treaty by acclamation. The Treaty was opened for signature at Washington, London, and Moscow on January 27, 1967.¹³⁶ The U.S. Senate gave unanimous consent to the Treaty's ratification and the agreement entered into force on October 10, 1967. Known formally as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, it is commonly referred to as the Outer Space Treaty.¹³⁷

The Treaty provides an institutional framework of international law applicable to outer space. To a large extent, the final text represents a law declaratory instrument codifying not only general principles announced through

General Assembly resolutions in the preceding ten year period, but also space resource participant practices and customs. Because it is substantially a document of codification, the Outer Space Treaty is indicative of the state of international law applicable to the space theater. Accordingly, the Treaty may constitute a ready institutional basis for claims and counterclaims bearing on weapons control in the expanded earth-space arena.

As a general principle of international law applicable to the conduct of national and multinational participant actions in space, the Treaty again invokes the general principles of peaceful purposes and peaceful uses. In preambular provisions of the Treaty, reference is made to "the exploration and use of outer space for peaceful purposes."¹³⁸ Resolution 1962 (XVIII), the Declaration of Legal Principles, and Resolution 1884 (XVIII), dealing with the obligation of states to refrain from the stationing of nuclear weapons or other weapons of mass destruction in space, are also specifically noted in the Preamble to the Treaty.¹³⁹

Immediately preceded by two general articles providing for international cooperation and a proscription on national appropriation in connection with outer space exploratory activities, Article III proclaims:

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter to the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.¹⁴⁰

Judging from these and other equally prominent references to "peace," "peaceful purposes" and "peaceful uses" found throughout the Treaty, it is apparent that this general principle was of some import to the drafters. Such terminology might at first glance suggest a possible basis for claims which assert the

impermissibility of weapons systems in space.

As is exhaustively explored in the legal literature surrounding the interpretation of the Treaty, significant interpretative differences existed between socialist and Western state participants as to the precise definition of the terms "peaceful purposes" and "peaceful uses." The Soviet bloc position as interpreted through the socialist dialectic of the law of peaceful coexistence maintained this language was synonymous with "nonmilitary." This early Soviet position, articulated even prior to Treaty negotiations, was largely predicated upon the policy needs of the socialist states to provide a framework for interpreting the United States satellite reconnaissance of Eastern bloc territories as a violation of international law. The Soviets argued that under a correct interpretation of "peaceful purposes" all military use of outer space, particularly the use of near space for reconnaissance satellites, was *ipso jure* illegal.¹⁴¹

Had the international community concurred that "peaceful purposes" and "peaceful uses" were synonymous with nonmilitary activity and had such interpretation been enforceable through the application of reliable sanctions, the impending generation of directed-energy weapons might well be subject to prohibition or limitation, at least with respect to near space, through the general principles of the Treaty. Whether such an interpretation, had it been adopted, would have withstood the forceful challenge of the claims asserting the permissibility of the directed-energy weapon, is quite another question. It may well be that some of the early efforts of the socialist and Western states alike to broadly interpret "peaceful purposes" would have been compromised in any case when confronted with the potent claims based on participant's exclusive national security interests. A participant state in pursuit of its national security interests might have been inclined to disavow its earlier

interpretation of these general principles if it considered the deployment or use of the directed-energy weapon overridingly essential to either the maintenance of its relative power position among other nations or, even more critically, its very existence as an independent state.

The second and ultimately prevailing interpretation of "peaceful purposes" and "peaceful uses," as used in the Treaty and other international institutions was advanced by the United States. The United States argued that these terms authorized military activity so long as it was nonaggressive.¹⁴² Professor P. G. Dembling, a member of the U.S. delegation to the Legal Subcommittee of COPUOS, in a study coauthored by Arons, reiterated the U.S. interpretation noting "(O)ne might conclude that any use of outer space must be restricted to non-aggressive purposes in view of Article III, which makes applicable international law, including the Charter of the United Nations."¹⁴³

Under this view, early U.S. satellite reconnaissance efforts, designed to ensure national and collective security for the U.S. and its allies by providing a means of advance warning of a preemptive Soviet attack, could be fully justified as consistent with international law. The United States argument was at least in part predicated upon the Antarctic Treaty which also invokes the terminology of "peaceful purposes" but which has not been interpreted so as to prohibit nonaggressive military use or involvement in exploratory or scientific activities.¹⁴⁴

The most persuasive argument, however, that the use of "peaceful purposes" and "peaceful uses" should be narrowly interpreted stems from a careful reading of the constraints on weapons and military activity contained in the Treaty itself. Pertinent Article IV provides:

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons

on celestial bodies, or station such weapons in outer space in any other manner.

The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited. 145

While under the terms of Article IV, states parties are enjoined to use the moon and celestial bodies for peaceful purposes, there is no application of such language to near space or even outer space beyond the introductory reference made to the general principles in the preambular provisions of the Treaty. Moreover, the second paragraph provides relatively narrow proscriptions with regard to the establishment of military bases, installations and fortifications, testing of weapons and the conduct of military maneuvers on celestial bodies. Indeed these particular prohibitions explicitly exclude near space, outer space and possibly even the moon itself.

Applying the rule of legal construction *inclusio unius est exclusio alterius* to the Article IV text and considering the prominently publicized military activities of the participant state superpowers before, at the time and subsequent to the adoption of the Treaty, there is little doubt but that references to the general principles of "peaceful purposes" and "peaceful uses" of outer space must be interpreted narrowly so as to authorize virtually all military activity in space not expressly prohibited. A number of legal scholars in their analyses of the Treaty would seem to confirm this reading of Article IV and the Treaty in general. 146

In referring to the scope of Article IV and its prohibitions within the general principle of "peaceful purposes," a former Secretary General of the

United Nations commented, "(T)he door is not yet barred against military activities in space. The crux of the difficulty is that space activity is already part of the arms race, a fact which we have to reckon with until humanity reaches the stage of an agreement on full and complete disarmament."¹⁴⁷

Further corroborating a restricted reading of the Treaty so as to construe a wide range of military activities as consistent with "peaceful purposes" and "peaceful uses," a serious but ineffectual effort was mounted by some state participants in the late 1960's to redraft and extend the scope of Article IV. Italy in a letter dated September 9, 1968 requested the inclusion of such a proposal on the agenda of the 23rd Session of the General Assembly.¹⁴⁸ Affirmative action was not taken on the Italian proposal and it was ultimately dropped because of tacit assurances from the major space resource states that deficiencies in the Treaty would not be exploited for unilateral military advantage.

There appears no strong foundation for claims of weapons prohibition or limitation based upon an argument that "peaceful purposes" or "peaceful uses" are synonymous with nonmilitary activity. If, however, military activity possibly including deployment of arms is authorized under the prevailing interpretation of the Treaty, a juridical analysis must determine whether any proscriptions do exist to such participant actions. Concomitantly, it must be determined whether such proscriptions specifically apply to directed-energy weapons systems and what the precise nature of these controls might be.

The salient language in the Treaty bearing on weapons control is enunciated in Article IV(1), "States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying *nuclear weapons or any other kinds of weapons of mass destruction*, install such weapons on celestial bodies, or station such weapons in outer space in any other manner."¹⁴⁹ (emphasis added)

Whether directed-energy weapons are subject to controls of any sort in effect depends on whether they are considered within these identified categories. Unfortunately, no provision in the Treaty attempts to define the terminology "nuclear weapons or any other kinds of weapons of mass destruction."

This so-called "no bombs in orbit provision" contained in Article IV(1) is a direct descendant of General Assembly Resolution 1884 (XVIII).¹⁵⁰ The unanimous adoption of this resolution may have been instrumental in both superpowers incorporating the language in their draft treaties and supporting its inclusion in the final consensus document.¹⁵¹ Article IV(1) does make it reasonably clear that deployment of nuclear and thermonuclear weapons in orbit is prohibited *per se*. However, the relative clarity of this proscription is offset by major ambiguities inherent in the residual text. What constitutes placing an object "in orbit around the Earth"? What is the meaning of the words "install" or "station" with regard to proscriptions bearing on the placement of weapons? In particular, what constitutes "any other kinds of weapons of mass destruction"? There may even be a question relative to the less ambiguous language concerning nuclear weaponry. What really constitutes a "nuclear weapon" for purposes of the Treaty? The answers to these questions bear directly upon the threshold query of the extent to which the comprehensive international law applicable to the earth-space regime controls directed-energy weaponry.

There is little consensus in either academic or political circles as to precisely what is meant in the use of the language "any other kinds of weapons of mass destruction." Professor Ogunbanwo offers one of many interpretations in his analysis of the Treaty. He notes: "The expression 'weapons of mass destruction' should be interpreted to include chemical, bacteriological, and any type

of weapon which could lead to the same type of catastrophe that a nuclear weapon could lead to."¹⁵² The Ogunbanwo interpretation is founded upon a belief that a general purpose interpretation of Article IV(1) would effectively prohibit devices which, like nuclear, chemical and bacteriological weapons, have the capability of inflicting damage to extensive geographical areas or injury to substantial populations. What is not clear from Ogunbanwo's analysis is precisely where he draws the line as to what destructive potential the weapon must actually have before it may be said to be a device which could lead to "catastrophy." Nor is it clear whether he draws any distinction as to the precision or discriminating characteristics of a weapon. Would the relatively discriminating weapon qualify notwithstanding the fact it has destructive potential comparable with a tactical or even strategic nuclear weapon? Would it make a difference that a weapon with great destructive potential could still be precisely trained on a military objective of great strategic value?

A second, if not equally ambiguous interpretation, may be taken to represent the official U.S. Government perception of the key Article IV(1) language. Former United States U.N. Ambassador Arthur Goldberg offered the following testimony in a dialogue with Senator Carlson at a 1967 Senate Committee hearing considering the impact of the Treaty on then existing U.S. space programs:

Senator Carlson. With respect to article IV, will you describe what is a weapon of mass destruction?

Mr. Goldberg. This is a weapon of comparable capability of annihilation to a nuclear weapon, bacteriological. (sic) *It does not relate to a conventional weapon.* (emphasis added)

Senator Carlson. This sounds ridiculous and wild, but I think I am correct in stating there was some thought of placing a satellite over Vietnam to keep that country lighted all night.

Mr. Goldberg. This would have no application.

Senator Carlson. This would have no application to that?

Mr. Goldberg. No. Observation satellites, navigational satellites, those are not covered by this treaty.

Senator Carlson. In other words, if we had done that and it could have been done, and I think it was actually considered in part of our military operation, it would not be affected?

Mr. Goldberg. It would not be affected by one iota by this treaty. (sic)¹⁵³

This interesting, albeit somewhat confused and less than articulate dialogue, illustrates the U.S. view that while the Article IV(1) provisions may proscribe weapons of comparable annihilative capability to devices using nuclear or bacteriological means of destruction, they would not bar the introduction of a more selective or conventional instrument. The analysis appears to parallel that of Professor Ogunbanwo to the extent it would define weapons of mass destruction in terms of annihilative or catastrophic destructive potential comparable to nuclear or bacteriological devices. However, whereas Ogunbanwo would apparently apply such standards to all coercive instruments, Ambassador Goldberg would exclude conventional weapons, notwithstanding the fact some may indeed possess tremendous destructive potential of their own.¹⁵⁴

Another weakness with Ambassador Goldberg's formulation is that it defines one ambiguous concept in terms of another. He does not make clear what he has in mind when he refers to a "conventional weapon." Nevertheless, it may be inferred from this definition that if a weapon is not a conventional device, it may qualify as a weapon of mass destruction. The question remains - if a hypothetical device is neither conventional nor a weapon of mass destruction because of its characteristics, then how is it classified? The effect of these open-ended definitions presented by Professor Ogunbanwo and Ambassador Goldberg is that they offer no concrete criteria for appraising the applicability of Article IV(1) to innovative weapons which do not lend themselves to classification within the traditional categories of conventional, nuclear, chemical or bacteriological weapons.

The most definitive expression of the term offered by the United Nations itself is found in a resolution of the Commission for Conventional Armaments

dated August 12, 1948. The resolution defined weapons of mass destruction as "atomic explosive weapons, radio-active material weapons, lethal chemical and biological weapons and *any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above.*"¹⁵⁵ (emphasis added) Some degree of continued U.N. support for this definitional concept is evidenced by the specific reaffirmation contained in General Assembly Resolution 84B adopted in December of 1977.¹⁵⁶ This resolution recognizes the problem of adapting the definition of 1948 to innovative weaponry. The resolution recognizes "that new weapons might be evolved on the basis of scientific principles other than those used in the weapons named in the 1948 definition of weapons of mass destruction."

The fact that General Assembly Resolution 84B (XXXII) purports to reaffirm the 1948 U.N. definition of weapons of mass destruction while concurrently recognizing the advent of new weaponry based upon innovative scientific principles suggests some basis for arguing that directed-energy weapons may be proscribed by Article IV(1) of the Treaty. However, at least two grounds exist upon which to base a counterclaim to this assertion.

First, while Resolution 84B (XXXII) received a substantial degree of support from the membership of the General Assembly, the vote was far from unanimous. Although only Albania voted against the proposal, the socialist bloc states and a number of the third world countries chose to abstain. A claim dependent upon a reading of the earlier U.N. definition to include weapons based on scientific principles other than those used in the weapons specifically mentioned in the 1948 statement, to be persuasive, requires a consensus of at least those participants possessing or developing these weapons systems. That claim is significantly weakened when a substantial bloc of participant states, which not only possess the traditional weapons of mass destruction but may be developing innovative weapons as well, choose to abstain from an effort to interpret

the 1948 definition as all inclusive.

A second ground upon which a counterclaim could be based is that even if Resolution 84B (XXXII) had been unanimously adopted, the 1948 definition would remain dangerously open-ended. The language in the 1948 definition "which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above" requires interpretation. As long as participants are authorized to render unilateral interpretations of that language, there is no objective standard for ascertaining which weapons are proscribed in Article IV(1) as weapons of mass destruction. Although efforts have been made to quantify the destructive effects of weapons, there is no indication the international community is prepared to adopt any universal criteria for appraising weaponry on this basis. ¹⁵⁷

The one thing which all these definitions of weapons of mass destruction appear to share is a notion that the method and level of destruction is a principal determinative factor in weapons classification. At the risk of oversimplification, it may be possible to infer from these statements that the more indiscriminate and less controllable a weapon tends to be and the greater its aggregate destructive force, the more likely it will be classified as a "weapon of mass destruction." If such an inference can be drawn, based upon the projected capabilities of high-energy laser and the particle-beam weapon, there would be a persuasive claim to inapplicability of Article IV(1). If indeed the extent and degree of destruction to human values and the indiscriminate character of the device are criteria for classification, it could be argued that each of these directed-energy devices may be operated with sufficient precision so as to avoid undesirable ancillary destruction or adverse environmental impact in areas tangent to the target.

It is the potential for discriminating and controllable use of the high-energy laser and particle-beam weapon which makes these instruments attractive candidates for participant military arsenals. Their probable use and design does not suggest easy comparison with nuclear, thermonuclear, chemical or bacteriological weapons which tend to exhibit the potential for ancillary destruction and injury.

At least one technical writer who has considered the coercive capabilities of the high-energy laser does not regard it as a weapon of mass destruction.

William Beane in his analysis of the HEL observes:

(T)he laser has other attributes, at least in the eyes of some. *It is a clean, discriminating weapon, not one of mass destruction.* When used where it can deliver lethal energy to a target, it could disintegrate, incinerate, melt, vaporize or cause to collapse planes, missiles, warheads, re-entry bodies, buildings or men, one at a time. Given its speed and precision, it can be used to do so only if its targets are themselves threatening. Because the laser is unique, it can be used in unique ways.
(emphasis added)¹⁵⁸

While acknowledging the tremendous destructive potential of the high-energy laser, it is interesting that Beane nevertheless regards its discriminating characteristics as sufficient to exclude it from the category of weapons of mass destruction.

Another reference to the question of Article IV(1) applicability to directed-energy weapons appears in a 1968 law review article by John Orr.¹⁵⁹ In his analysis of the arms control provisions of the Outer Space Treaty, Orr explores not only the meaning of "weapons of mass destruction" but also the implications suggested by the language "nuclear weapons." Referring to "weapons of mass destruction," Orr generally concurs with other analysts that the Treaty prohibits arms which employ bacteriological and chemical agents to reap their destruction.¹⁶⁰ He also agrees that Article IV(1) probably does not apply

to even the most massive of conventional explosive devices, but that in all other respects the meaning of "weapons of mass destruction" turns upon the extent of destruction or loss of human life.

Of greater significance, is Orr's analysis of whether an "atomic heat ray" would be permissible under the Article IV(1) language prohibiting "nuclear weapons" in orbit around the earth. He notes:

Even a term seemingly so clear as "nuclear weapon" is subject to conflicting interpretations when read in the context of a particular military system. One long range proposal for a defensive system against missiles includes a satellite using a focused beam of radiation from a nuclear reactor as an atomic heat ray to destroy an enemy missile.

. . . .

A nuclear reactor used as the source of a radiation beam differs from the usual nuclear weapon in that it does not explode. While it is nuclear and a weapon, it is not necessarily therefore a weapon of mass destruction. Article IV could be read as prohibiting only nuclear weapons of mass destruction. Some support is found for this view in the Treaty language "nuclear weapons or any *other kinds of weapons of mass destruction* It could be argued that the use of "other" implies that nuclear weapons were included only as an example of what the Treaty provision was actually intended to prohibit - weapons of mass destruction. This being true, then the status of a nuclear weapon under the Treaty should be decided on the basis of whether it can cause mass destruction. (emphasis in original text)¹⁶¹

Orr hastens to make clear however, that this argument is not accepted by the United States Department of State:

In rejecting this argument, the Legal Adviser to the Secretary of State, Leonard C. Meeker, stated that 'any nuclear weapon is forbidden in space . . . (e)ven a small one is considered . . . to be a weapon of mass destruction.' His interpretation of the language would read 'other' as assimilating nuclear weapons to weapons of mass destruction, and prohibiting both.¹⁶²

Although Orr fails to fully explain all the implications and bases for this argument, he nevertheless suggests an interesting basis for the development of a claim. It appears an argument exists that the language "nuclear weapons"

encompasses devices that produce massive destruction in the target area. Such an argument assumes that perhaps some types of nuclear weapons, particularly nonexplosive or discriminating devices, may not constitute weapons of mass destruction. Specifically, despite the fact the PBW or "atomic heat ray" may depend upon a nuclear reaction to generate a beam, the fact such instrument may be able to destroy discriminately may remove it from the proscribed category of weapons.

Another view pertaining to which weapons may be proscribed under Article IV(1) of the Treaty is offered by space law authority Stephen Gorove. Gorove observes:

It may be presumed that *all arms which utilize atomic energy in accomplishing their intended purpose, irrespective of their size or destructive force*, would be regarded as nuclear weapons. At the same time, it also may be assumed that conventional weapons do not come under the category of either nuclear weapons or any other weapons of mass destruction. While there is no indication in the Treaty as to how many people must be affected to constitute a weapon of mass destruction, a group of 20 to 30 people or less probably would not constitute such a mass. If on the other hand, bacteriological and chemical weapons were used, even against a small group, then these weapons would seem to fall under the category of weapons of mass destruction. (emphasis added)

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Gorove's "assumptions" bring him perilously to conclude all nuclear, bacteriological and chemical weapons are proscribed without reference to their destructive potentialities. Without further qualification, it would seem such an analysis would prohibit even nonlethal devices within these categories. Even the relatively innocuous tear gas, under this analysis, constitutes a proscribed weapon of mass destruction. Moreover, as in the case of other definitions, the somewhat superficial conclusion is reached that weapons of mass destruction must automatically exclude all conventional weapons systems without regard to their destructive potential. Apparently the only questionable category for Gorove would be instruments of coercion which have not been

previously classified as nuclear, chemical, bacteriological or conventional. In this case, he would inquire as to their potential to "affect" some undetermined number of people, apparently greater than twenty to thirty in number.

The Gorove interpretation is of little benefit in interpreting Article IV(1). To the extent that the PBW could be regarded as a nuclear device, it might be proscribed regardless of its discriminating characteristics. The high-energy laser, assuming it was not regarded as a chemical weapon and accordingly proscribed *ipso jure*, would presumably fall into the nebulous category of unclassified weapons. If so, under Gorove's analysis, the HEL device would then be judged as to its "affect" on the unspecified number of persons.

Elsewhere in his analysis and with reference to a second major ambiguity in Article IV(1), Gorove propounds a somewhat more concrete interpretation of whether the high-energy laser qualifies as a weapon of mass destruction:

The primary obligation in paragraph one [Article IV(1)] concerning 'nuclear weapons and any other kinds of weapons of mass destruction' is that the states parties to the Treaty undertake not to place in orbit around the earth any objects carrying such weapons. The phrase 'orbit around the earth' clearly implies that a full orbit rather than a fractional orbit or suborbital flight is intended. Thus, the provision is not meant to outlaw the use of ICBM's with nuclear warheads. At the same time, an *orbiting missile killer or laser would be prohibited, regardless of whether or not it was intended for defensive or offensive purposes.* (emphasis added) 164

Implicit in this pronouncement is Gorove's assumption that lasers and other "missile killers" are automatically included as weapons of mass destruction. Under Gorove's interpretation, it would seem even the antisatellite interceptor vehicles currently under development would be proscribed if they had the capability of destroying a maneuverable vehicle notwithstanding the fact the first generation of such devices will probably destroy their prey by

exploding shrapnel with conventional charges or, alternatively, through direct high velocity impact with the target.¹⁶⁵ Gorove's analysis of laser and missile killer weapons in some respects appears to contradict his general thesis regarding the criterion of destructive "affect" on the undetermined number of people.

Gorove's overall interpretation of Article IV is that it should be construed so as to prohibit activities which constitute a threat to national security.¹⁶⁶ He would examine the nature of the activity and determine whether it should be prohibited. However, his assessment of the laser and missile killer seems to ignore not only the language of the Treaty itself but falls error to the unsupported and prejudicial assumption that weapons not clearly authorized, should when possible, be interpreted as illegal and a threat to the minimum world public order system. He assumes further that such weapons pose more than a minimal threat to national security. As indicated earlier, this is an assumption which if not analyzed fully can produce superficially attractive but legally erroneous results. While there may be merit in Gorove's interpretative concept, it would be far more persuasive if its determination of a weapon's threat to national security was based upon an indepth analysis of the instrument itself rather than upon assumptions as to its legality.

Amplifying the ambiguity inherent in Article IV(1) is the issue of what is meant by "to place in orbit around the Earth." Again the text of the Treaty and even the *travaux-preparatoires* offer little guidance in interpreting this key phrase.¹⁶⁷ As in the case of other ambiguous terminology in Article IV(1), the analyst must examine other interpretative evidence such as the apparent intentions and conduct of the participants both when entering into and subsequent to the Treaty's coming into force.

At issue is the point at which an object may be said to be "in orbit" for purposes of the prohibition. Is it necessary that the object actually circumnavigate the earth or is it sufficient that it merely have such potential if allowed to pursue its natural course? This question may be examined in light of at least some empirical evidence of participant state actions and interpretations. Concurrently with the negotiation and entering into force of the Outer Space Treaty, the Soviet Union tested its Fractional Orbital Bombardment System (FOBS). The FOBS was designed to launch a nuclear or thermonuclear warhead into a near earth orbit of about 100 miles altitude. Once the launched FOBS warhead approached its target and before it had completed one earth orbit, retrorockets slowed the device causing it to drop on the objective. The apparent Soviet objective in developing FOBS was to provide a delivery system which could achieve a surprise nuclear strike. Since the Western distant early warning system was essentially oriented toward detection of an ICBM or bomber attack launched through a north polar trajectory, the FOBS would offer the Soviets the capability of delivering a surprise strike by sending nuclear devices through the unmonitored Southern Hemisphere.¹⁶⁸

The immediate question was whether the partial orbit of the FOBS violated Article IV(1). The U.S. Government's interpretation was equivocal at best. Ambassador Goldberg called the testing of the FOBS "a matter of great concern" but offered no comment as to the legality of the Soviet testing under the Treaty or any other aspect of international law.¹⁶⁹ The National Aeronautics and Space Administration offered a definition of "orbit" which seemed however, to render the FOBS in violation of the Treaty. NASA defined orbit as "the path of a body under the influence of a gravitational or other force . . . path relative to another body around which it revolves."¹⁷⁰ This definition rendered at least the actual use of the Soviet FOBS in violation of the Article IV(1)

provisions since it was based on whether a vehicle achieved a path which would lead to circumnavigation of the earth. The NASA definition disregarded the fact of whether circumnavigation actually resulted.

In contrast, Gorove argued that "The phrase 'orbit around the earth' clearly implies that a full orbit rather than a fractional orbit or suborbital flight is intended."¹⁷¹ The facts suggest at least unofficial if not official concurrence with this view of FOBS legality under the Treaty. The Department of Defense issued a statement in November of 1967 that "weapons that do not stay in space for one complete orbit are not considered to be in space."¹⁷² Subsequently, space technology journalist William Leavitt reported that Secretary of Defense Robert McNamara as well as Secretary of State Dean Rusk had publicly disclosed their views that the Soviet FOBS did *not* violate the provisions of the Treaty.¹⁷³

Additional views on the interpretation of this language are offered by Orr in his analysis of the Treaty:

In looking at the entire Treaty to ascertain purpose, the language of Article I requiring the 'use of outer space . . . in the interests of all countries' seems to weigh against the propriety of FOBS. While an ICBM simply passes through space while travelling between two points on earth, a FOBS vehicle 'uses' space in the sense that a satellite 'uses' space to remain in orbit.

On the other hand the brief time spent in space by a FOBS vehicle, more or less corresponding to that spent by an ICBM, could justify analogizing it to an ICBM, which does not violate the Treaty. In further defense of FOBS, it should be noted that the United States knew about the probable development of the Soviet FOBS during negotiations of the Treaty and failed to object to it during or since that time.¹⁷⁴

Orr suggests that the principle of "peaceful uses" invoked by the Treaty may be an argument against the FOBS. However, he correctly notes the persuasive value of this argument is diminished by the fact the ICBM which by practice and tacit mutual consent of the superpowers is rather clearly a permissible space vehicle. In recognizing the analogy between the FOBS and ICBM, it

should be remembered that the ICBM's ballistic trajectory is very similar to the partial orbit employed by the Soviet FOBS. The essential difference is that the ballistic missile trajectory is sufficiently elliptical to bring it back to earth by function of its own path whereas the FOBS uses a relatively more circular orbit which requires inducement to bring the warhead down on target.

The persuasive weight of authority, particularly in view of unilateral acquiescence by the United States to the FOBS testing, is that a complete orbit of the proscribed weapon must be completed before Article IV(1) can be invoked. Hence, regardless of whether the PBW and HEL are classified as weapons of mass destruction, if they are deployed in only partial orbits, they are not violative of Article IV(1) of the Treaty. The same is true if they are used in a ballistic trajectory. It must be said that deployment limited to a partial orbit or ballistic trajectory would generally not be a cost-effective way to utilize a directed-energy weapon. Typically, such devices would be of greatest value if stationed on a relatively permanent basis in near space where they might be used as the destructive mechanism in either a antisatellite (ASAT) or antiballistic missile (ABM) system. However, should such devices eventually be capable of efficient application against land or sea targets, the exception to the application of Article IV(1) based on the need for a fully orbiting device would allow an attacker to employ these weapons. A high-energy laser, for example, might be launched into a nonorbital trajectory sufficiently high to allow it to engage in a rapid firing attack on enemy positions. Following the limited time attack, the laser weapon could be retrieved by the launching state and used in successive attacks aboard new vehicles.

The overridingly important point however, is that once again the Article IV language in the Treaty has been interpreted narrowly. Again the interpretation renders impermissible only that which is explicitly prohibited.

The result of this interpretation is simply to further underscore the unreliability of the Outer Space Treaty as an institutional basis for persuasive claims to arms control.

Other shortcomings and ambiguities in the text of Article IV of the Treaty tend to confirm the unreliability of this institutional instrument as an effective means of prohibiting or limiting directed-energy weapons. First, in what is admittedly a very narrow constructionistic argument, the language of Article IV(1) proscribes placement "in orbit around the Earth" of "*any objects carrying*" the prohibited weapons.¹⁷⁵ In the same clause, parties undertake not to "install such weapons on celestial bodies, or station such weapons in outer space in any other manner."¹⁷⁶ Interpreted through narrow and strict construction, it is possible to argue that what is prohibited with regard to near space is only the delivery system and not the weapon itself.

This constructionistic argument is based upon the internal variance in the language found in Article IV(1). Read narrowly, it can be argued that the language prohibits only the orbiting of the "objects carrying" the prohibited weapon and not the weapon itself. The same sentence explicitly states that it is prohibited to "install such *weapons* on celestial bodies" or to "station such *weapons* in outer space in any other manner." The argument implies that if Article IV(1) were meant to proscribe weapons in orbit, it would not have referred to "objects carrying" but instead to the "weapon" itself as was done in the case of celestial bodies and outer space.

This sort of constructionist argument obviously tends to defeat the general purpose of Article IV(1) as well as the peaceful purposes and peaceful uses intent which pervades the Treaty as a whole. Nevertheless, this constructionist argument is possible under a narrow reading of Article IV and is one more indication of the unreliability of the Treaty as an institutional basis for claims

to arms control.

Additional ambiguity can result from varied interpretations of the terms "install" and "station" as used in Article IV(1). Through narrow interpretations of these terms it is again possible to achieve results which may be contrary to the general principles of "peaceful purposes" or "peaceful uses" as employed in the Treaty. A claimant employing a narrow construction of the term "station" for example, might argue that such language was only meant to embrace actions which involve the placement of a weapon in a relatively fixed location and that a device the position of which is changed from time to time would therefore not fall under the regulatory regime of Article IV(1). Certainly such tortured interpretation is not endorsed in this study. However, the fact that such an argument can be posited is evidence of just one more ambiguity in the Outer Space Treaty's arms control measures.

The language in Article IV is perhaps equally important for what it fails to say. Article IV(1) bars deployment of certain categories of weapons. However, it does not address other phases or aspects of the weapons evolution including research, development, testing or even use. This omission, particularly as regards the testing of weaponry, appears no oversight when examining other language in Article IV(2) which provides "the testing of any type of weapons . . . on celestial bodies shall be forbidden."¹⁷⁷ If testing of weapons of mass destruction was to be proscribed by Article IV(1), why didn't drafters include identical language in both paragraphs?

Finally, despite the prohibition of general classes of weapons, the Treaty offers no comprehensive system of enforcement and verification. The Treaty's only sanctioning and enforcement system exists in the limited provisions afforded in Article IX allowing state parties to "request consultation" concerning the activity or experiment of another state party in outer space which the requesting state has reason to believe would cause potentially harmful interference with activities in the peaceful exploration and use of outer space.¹⁷⁸

With a weak enforcement mechanism of this type, participant states are not likely going to commit themselves to anything other than the narrowist interpretation of Article IV. No state whose national security interest is dependent upon continued free access to near space will stake its territorial and political integrity upon as weak a sanctioning system as contained in the Treaty.

Experience suggests these shortfalls coupled with the ambiguous language of the Treaty, have only served to channel, not inhibit, the military strategies of the major space resource states. As already noted, the Treaty had little or no effect on the Soviet development and testing of its FOBS. Perhaps even more telling is the fact the Treaty was apparently not considered as a viable institutional basis upon which to claim illegality of the Soviet system. This is interesting considering that the U.S. had no such system of its own and was clearly the primary participant against whose interests the FOBS was being developed. If the Treaty provisions had been a viable arms control basis, why wouldn't it have been in U.S. exclusive if not inclusive interests to assert such a claim?

Additional state practice suggesting the Treaty's unreliability as an arms control institution stems from the significant research, development and even testing of ASAT systems. At about the time the Treaty was coming into force, the Soviets commenced testing of a first generation antisatellite interceptor vehicle.¹⁷⁹ More recently, the United States has contracted with the Vought Corporation of Dallas, Texas, and other aerospace concerns to develop similar if not more sophisticated vehicles with antisatellite destructive capabilities.¹⁸⁰ This significant level of military development and testing, notwithstanding the Treaty, graphically illustrates the narrow construction applied in practice by the principal space resource states to the arms control provisions of the Treaty. In practice, unless a military activity

is explicitly prohibited, it is considered permissible under Article IV and the Treaty's ancillary arms control principles.

Considering the ambiguities in language, an inadequate sanctioning system and the tendency in practice for states to interpret controls narrowly, there seems little reason to believe the Outer Space Treaty would apply to prohibit or limit directed-energy weapons. The characteristics and capabilities of the directed-energy weapons will probably qualify them as "nuclear weapons or other kinds of weapons of mass destruction" only under the broadest interpretation of Article IV(1). The terminology "nuclear weapons or other kinds of weapons of mass destruction" under most interpretations does not appear to incorporate devices with characteristics and capabilities of either the high-energy laser or particle-beam weapon. Neither instrument applies its coercive force through a direct nuclear explosion. Neither can really appropriately be construed as within the established categories of bacteriological, chemical, radiological or nuclear devices. Both exhibit potential for being relatively more controllable and discriminating than most known weapons of mass destruction in participant arsenals.

Admittedly an argument exists that the deployment of such weapons might violate the "spirit of the Treaty." It can be argued that directed-energy weapons are inconsistent with the general principles of "peaceful purposes" and "peaceful uses" of space. However, these arguments will not be accepted in practice as clearly evidenced by the experience with both the Soviet FOBS and the superpower thrust to develop an ASAT. In short, the claims asserting the Outer Space Treaty does not apply to prohibit or limit the research, development, testing, production, stockpiling, deployment and even use of directed-energy weaponry are far more persuasive than counterclaims to the contrary.

C. The Contemporary Law of Strategic Arms Control

The third set of institutional bases to be considered as a source of claims bearing on the control of directed-energy weapons involves the contemporary law of strategic arms control. Unlike the preceding two sets of bases considered within the comprehensive international law regime applicable to the earth-space arena which were multilateral in nature, this third set of bases is primarily composed of bilateral institutions. To the extent that participants may use the strategic arms control law to advance their individual national security interests or preserve important values, these bilateral institutions and claims based upon them may be considered oriented toward exclusive interests.

At the same time, inclusive participant interests may be at work in the functioning of these institutions. To the extent claims based upon the law of strategic arms control tend to dampen participant arms competition, they may serve the inclusive interests in avoiding massive coercion and seeking resolution of disputes through peaceful, persuasive mechanisms. As noted previously, strategic arms control measures are generally premised on the assumption that limitation of weapons systems will discourage the competition between the superpowers and thereby promote bilateral stability. To the extent this assumption is realized, it is clear inclusive interests are served.

An examination of these institutions and their derivative claims to weapons control also suggests they are oriented toward conservation of participant values. The principal participants, the superpowers, appear to pursue the control of certain weapons systems to maintain a status quo or at least slow competition in weaponry. The primary purpose of this exercise is apparently to avoid any unilateral development which would interfere with the existing balance of power maintained through the strategy of mutual deterrence.

1. The ABM Treaty

The principal strategic arms control institution having potential application to directed-energy devices is the Anti-Ballistic Missile or ABM Treaty.¹⁸¹ The ABM Treaty, which entered into force October 3, 1972, constitutes an agreement between the Soviet Union and United States to limit the deployment of anti-ballistic missile facilities to two sites per participant. The expressed purpose of the Treaty is to leave unchallenged each participant's penetration capability of the other's retaliatory missile forces. Precise qualitative and quantitative limits are placed on the ABM systems deployed. Since the directed-energy weapons under research and development may have an anti-ballistic missile potential, the ABM Treaty must be closely examined to ascertain whether its limitations apply.

Article I of the ABM Treaty provides:

1. Each Party undertakes to limit anti-ballistic missile (ABM) systems and to adopt other measures in accordance with provisions of this Treaty.
2. Each Party undertakes not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense, and not to deploy ABM systems for defense of an individual region except as provided for in Article III of this Treaty.¹⁸²

The referenced Article III simply prohibits all deployment of ABM systems or their components except for the two land-based deployments authorized in accordance with that article. Based upon what is already known about the anti-ballistic missile potential of the directed-energy weapons currently under research and development, it might appear at first glance that Article I imposes concrete limitations upon directed-energy weapons deployed in an anti-ballistic missile mode. However, certain ambiguities with respect to what is and what is not an "ABM system" may present an interpretative problem.

The focus of the interpretative problem with respect to the key terminology "ABM system" arises out of the definition stated in Article II(1) of the ABM Treaty:

1. For the purpose of this Treaty an ABM system is *a system to counter strategic ballistic missiles or their elements in flight trajectory*, currently consisting of:

(a) ABM interceptor missiles, which are interceptor missiles constructed and deployed for an ABM role, or of a type tested in an ABM mode;

(b) ABM launchers, which are launchers constructed and deployed for launching ABM interceptor missiles; and

(c) ABM radars, which are radars constructed and deployed for an ABM role, or of a type tested in an ABM mode. (emphasis added) 183

The foregoing definition makes it clear that in the first instance an "ABM system" is one which counters strategic ballistic missiles or their elements, primarily warheads, while in flight trajectory. Employing this part of the definition alone, it appears the ABM Treaty proscriptions would be applicable to directed-energy weapons which are tested or deployed for purposes of providing an anti-ballistic missile defense.

However, when the remainder of this rather complex definition is examined, its applicability to innovative weaponry becomes less clear. In an attempt to clarify the meaning of the term "ABM system," the definition cites certain specific components including "interceptor missiles," "launchers" and "ABM radars." Directed-energy weapons do not possess such components. The issue is essentially whether through the use of the language "currently consisting of" the participants intended to provide only an example of one possible ABM system known to the parties at the time of entering the ABM Treaty, or alternatively, whether Treaty Article II(1) constitutes an exhaustive or exclusive enumeration of such components. If the listing of the various components is only a contemporary example of an existing ABM system which might well be supplemented by future systems, then subsequent weapons would presumably be includable.

Alternatively, if the listing of ABM components was intended to constitute an exclusive enumeration of such components, then the ABM Treaty would have to be modified in order to extend to innovative ABM systems not envisioned by the participant negotiators at the time of drafting.

Unfortunately, the working papers and authoritative documentation surrounding the ABM Treaty negotiations are classified making it impossible to accurately assess precisely what participant intentions may have been with regard to Article II(1). However, the unclassified portion of the Fiscal Year 1979 Arms Control Impact Statements may provide at least the U.S. perspective in connection with its discussion of directed-energy weaponry. The pertinent statement concerning the potential applicability of the ABM Treaty to the particle-beam weapon provides:

The current PBW programs are not constrained by existing arms control agreements. However, the BMD (ballistic missile defense) potential of future PBW's creates a possible conflict with regard to the 1972 ABM Treaty. Article V of the ABM Treaty prohibits the development, testing or deployment of all types of ABM systems or their components that are sea-based, air-based, space-based, or mobile land-based. Article III of the ABM Treaty prohibits all deployment of ABM systems or their components except for the two land-based deployments permitted pursuant to such article. Article II defines an ABM system as a 'system to counter strategic ballistic missiles or their elements in flight trajectory; and describes current systems as consisting of ABM interceptor missiles, ABM launchers and ABM radars. [Deleted.] Thus PBW's used for BMD which are fixed land-based could be developed and tested but not deployed without amendment of the ABM Treaty, and the development, testing, and deployment of such systems which are other than fixed land-based is prohibited by article V of the treaty. 184

Although even a portion of this commentary has been deleted for security reasons, the language suggests that the U.S. perspective of the terminology "ABM system" as contained in Article II(1) may include at least the particle-beam weapon. Whether or not a similar analysis may apply to high-energy lasers is unclear since the applicable portion of the statements has been

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deleted again for security reasons. However, it might be possible to infer that the same operative interpretation of Article II(1) would apply to either type of directed-energy weapons system.

Notwithstanding these inferences regarding the probable United States interpretation of the scope of Article II(1) of the ABM Treaty, a strong counterclaim exists suggesting the inapplicability of this definition to directed-energy weapons. Agreed Interpretation [E] of the Protocol to the Interim Agreement contains language which suggests that the ABM Treaty definition may be narrower than the apparent U.S. perception would admit. This authoritative bilateral interpretation states:

In order to insure fulfillment of the obligation not to deploy ABM systems and their components except as provided in Article III of the Treaty, the Parties agree that in the event ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars are created in the future, specific limitations on such systems and their components would be subject to discussion in accordance with Article XIII and agreement in accordance with Article XIV of the Treaty. 186

Agreed Interpretation [E] read *in pari materia* with Article II(1) of the ABM Treaty firmly implies that the original definition was not intended to extend to "ABM systems based on other physical principles." Certainly an ABM system which employs either a HEL or PBW device would constitute one based on other physical principles. Accordingly, it would seem that while the parties to the Treaty may be obligated to consult pursuant to their obligations under Articles XIII and XIV,¹⁸⁷ such systems may not be limited under the terms of the Agreement itself. At very minimum, a counterclaim of this nature based on Agreed Interpretation [E] places the applicability of the ABM Treaty with regard to directed-energy weapons in grave doubt despite the apparent U.S. interpretation of Article II(1).

If the ABM Treaty's definition of "ABM system" does include directed-energy weaponry, then Article V(1) would provide a limitation on the development, testing and deployment of certain systems.¹⁸⁸ The language does not provide a complete prohibition however, since it only applies to air-based, space-based, sea-based or mobile land-based systems. Specifically excluded from controls under this provision is the fixed or permanent land-based ABM system for which development, testing and deployment of appropriate ABM systems may continue within the constraints elsewhere provided. In view of the probable ease with which the technology involved in a fixed land-based system could be adapted to a mobile system, even if this limitation does apply to directed-energy weapons, it appears a less than reliable or credible control.

Regardless of whether the central substantive provisions of the ABM Treaty have functional applicability to directed-energy weapons systems, an ancillary enforcement provision is almost certainly relevant. Article XII of the ABM Treaty provides *inter alia*:

1. For the purpose of providing assurance of compliance with the provisions of this Treaty, each Party shall use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law.

2. *Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article. (emphasis added)*¹⁸⁹

The significance of the Article XII(1) and (2) language is its explicit law declaratory authorization for each party to conduct virtually unlimited satellite reconnaissance of the other's resources. Despite the fact the Soviets once clearly opposed such satellite reconnaissance, it is clear from their agreement to this language, that their position has changed. Article XII(2) effectively prohibits any action by the reconnoitered party which might limit

the capability of the verifying party to ensure compliance with the proscriptions of the Treaty.

While these provisions in no way serve to prohibit or limit the development, testing or deployment of directed-energy weapons, either in space or on the earth's surface, they certainly render their use against certain reconnaissance and remote sensing satellites in contravention of international law. The major ambiguity may be precisely what space resources constitute "national technical means of verification." In any case, the apparent commitment to a principle of noninterference is bolstered by the fact identical language was written into Article V of the five year Interim Agreement on the Limitation of Strategic Offensive Arms which entered into force October 3, 1972.¹⁹⁰

Since directed-energy weapons are generally still in the developmental stage, there is almost a complete absence of any state practice which might be used to illustrate the application of this or any other institution in the aggregate claims-counterclaims process. However, a much debated and intriguing incident occurred in October and November of 1975 which may well portend of future events. On October 18, 1975, a U.S. Air Force early-warning satellite and companion support vehicle in orbit over the Indian Ocean, engaged in monitoring Soviet ICBM silos, were illuminated by an energy source 10 to 10,000 times the intensity typically received from a ballistic missile launch or natural sources such as forest fires or volcanoes. So intense was the radiation, that infrared sensors aboard the strategically critical satellite were temporarily blinded. Five similar incidents followed between the initial October illumination and early December of 1975. On each occasion, an early-warning satellite was incapacitated by an unknown energy source originating somewhere in the western Soviet Union.¹⁹¹ On one occasion the intense

illumination persisted for a period of more than four hours although none of the incidents resulted in permanent damage to the satellite.

Since the Indian Ocean early-warning satellite had been in service for more than five years and sensor degradation had been recorded earlier, it was initially suspected that an avionics malfunction had been the cause of the incapacitation. However, a few weeks after the initial incident, on November 17 and again on November 18, two other U.S. Air Force satellites, this time in far more elliptical orbits, experienced similar incapacitation of their infrared horizon sensors while over the Soviet Union. Infrared imagery from defense meteorological satellites was examined for those days during which the illuminations occurred and no natural sources of strong radiation were found. The infrared sensors on these satellites were designed to function with a peak radiation sensitivity at a wavelength of approximately 2.7 microns. Interestingly enough, this closely approximates the wavelength of high-energy hydrogen-fluoride lasers.¹⁹²

Whether or not the Soviets intentionally employed a high-energy chemical laser to incapacitate these U.S. strategic satellites has since become a matter of considerable contention. The official United States position articulated by then Secretary of Defense Donald H. Rumsfeld, was that the satellites had probably been dazzled by the glare from natural gas fires.¹⁹³ The U.S. itself has employed low intensity laser radar located at sites including Cloudcroft, New Mexico, and Maui, Hawaii, to "interrogate" Soviet reconnaissance satellites passing overhead. These laser radar facilities are used to determine precise orbital parameters of the satellites. They are also used to determine if the Soviet satellite passing overhead carries a reconnaissance camera by measuring laser energy reflected back from exposed optical systems.¹⁹⁴

In view of the U.S. application of laser radar, another possibility seemed to be that the incidents were nothing more than innocent but perhaps technically bungled Soviet attempts to "interrogate" U.S. satellites.¹⁹⁵

Some analysts question why, if the Soviets have the means to incapacitate U.S. satellites, they would risk disclosure of so important a capability in an incident which would net virtually no military or political gain. If anything, incidents such as the 1975 "blindings" might be expected to stimulate satellite "hardening" and defensive countermeasures. Moreover, the Soviets might well have expected the United States would counter by initiating a program to develop its own laser antisatellite capability. Worse yet, if the U.S. had already secretly developed such capability, the Soviets might have risked possible retaliation in kind against one of their critical satellites. Finally, these analysts reason that the Soviets would be far more apt to conduct such an operation against their own test satellites allowing the collection of valuable target effect data in a completely controlled experiment.¹⁹⁶

Since the U.S. Defense Department ultimately determined that there was insufficient evidence to conclude these incidents had been the result of intentional Soviet actions, there appeared no basis to claim a breach of Article XII(2) of the ABM Treaty. However, it is implicit from a recently released compliance report of the U.S. Arms Control and Disarmament Agency, (ACDA), that had the 1975 events been the result of intentional Soviet high-energy lasing of American satellites, such actions might well have been interpreted as interference with the U.S. national technical means of verification in contravention of the Treaty. With regard to the incident, the ACDA report noted:

Soviet use of something like laser energy to 'blind' certain U.S. satellites could be an activity inconsistent with the obligations in Article XII of the ABM Treaty and Article V of the Interim Agreement 'not to interfere with' or 'use deliberate concealment measures' which impede verification, by national technical means, of compliance with provisions of those agreements. In 1975, information relevant to possible incidents of that nature was thoroughly analyzed, and it was determined that no questionable Soviet activity was involved and that our monitoring capabilities had not been affected by these events. The analysis indicated that the events had resulted from several large fires caused by breaks along natural gas pipelines in the USSR. Later following several reports in the US press alleging a Soviet violation, and in response to questions about those reports, the US press was informed of those facts by several US Officials.¹⁹⁷

The October-November 1975 "blinding incident" and the response of U.S. decision-makers exemplifies the probable claims potential of Article XII of the ABM Treaty as a means of restraining the use of directed-energy weapons against at least those satellites used for verification of the strategic offensive arms listed in the Interim Agreement and ABM systems addressed in the ABM Treaty. Of equal importance, the incident illustrates the propensity for conflicting factual interpretations of the same data concerning events in this area. It may be expected that confusion and the resulting disputes over the correct interpretation of what in fact occurred will increase as directed-energy weapons become a reality in the earth-space arena.¹⁹⁸

The 1975 incident may also portend of some of the strains, suspicions and risks which this new weaponry will visit on the minimum public order system.¹⁹⁹ With the advent of this weaponry capable of instantaneously incapacitating strategically critical defense systems, there will be greater need than ever for participants to accurately collect, analyze and respond to the available empirical data. One factor in particular that at least the Soviet Union and United States should clarify to each others satisfaction, is

precisely which satellite vehicles are subject to the protection of the ABM Treaty and Interim Agreement. As one space authority notes, an argument could even have been made with respect to the 1975 incident, that the satellites "blinded" were technically not within the protected category of "national technical means of verification."²⁰⁰ Since the "blinded" satellites were early warning satellites and not directly engaged in verification of quantities of strategic weapons or ABM systems, they were not subject to special protection against interference.

2. Ancillary Provisions and Forums for Claims Assertion

As previously noted in connection with Agreed Interpretation [E] of the Protocol to the Interim Agreement, certain provisions in the ABM Treaty provide for consultation between the parties.²⁰¹ Article XIII of the Treaty provides for the establishment of a "Standing Consultative Commission" (SCC) between the parties to carry on a dialogue with respect to compliance.²⁰² Article XIV of the ABM Treaty provides that each party may propose amendments to the Treaty and also that there be a periodic review of the ABM Treaty at intervals of five years.²⁰³ Since the proceedings of the SCC are not publicly disclosed to encourage an open and frank exchange of politically sensitive positions, it is not possible to ascertain whether the subject of directed-energy ABM systems has been raised by either party in this forum.²⁰⁴ Since available technical information strongly suggests that at least the PBW's, if not certain high-energy laser systems, have been seriously considered for their operational ABM potential, it would appear likely that if this subject has not as yet been raised in the SCC, eventually it will be.²⁰⁵

The Protocol's Agreed Interpretation [E], by invoking ABM Treaty Articles XIII and XIV, offers some indication of the extent of the parties' responsibility to consult or seek appropriate amendments vis-à-vis ABM systems based on other physical principles. It seems likely that this obligation to consult through the SCC extends to possible unintended, if not intended, interference with the protected class of national verification satellites. A key provision contained in Article XIII of the ABM Treaty provides that the parties will employ the SCC to "consider questions involving unintended interference with national technical means of verification."²⁰⁶ Hence, reading Agreed Interpretation [E] *in pari materia* with the referenced Article XIII of the ABM Treaty, parties appear to be under an obligation to consult regarding the development of innovative ABM systems and their components as well as with respect to the unintended interference with verification apparatus employed to enforce the Treaty itself. Under this interpretation, either party could, if it elected to do so, raise the question of a possible directed-energy attack on one of its ABM verification satellites. There is, however, no publicly available information to suggest this has as yet occurred in any of the SCC proceedings.

While the Standing Consultative Commission is available as one bilateral forum for the consideration of certain claims and counterclaims bearing on the control of directed-energy weapons, Soviet and American negotiators are clearly probing alternative approaches. Growing concern over the advanced Soviet testing and possible future deployment of antisatellite interceptors or so-called "killer satellites" prompted the Carter Administration as early as March of 1977 to propose bilateral talks on the question of ASAT's.²⁰⁷ In a recent State Department response to a Congressional inquiry, Douglas J. Bennet Jr., the Assistant Secretary for Congressional Relations stated:

We do wish to point out, in regard to (deleted) inquiry concerning diplomatic approaches, that the question of arms limitations with respect to potential anti-satellite activities has in fact been taken up with the Soviet Union. In his March 9, 1977 press conference, President Carter indicated that the United States had made certain suggestions to the Soviet Union with regard to a possible agreement in this area. This topic was raised with the Soviets in March, and as Secretary Vance subsequently indicated in public comments, the United States and the Soviet Union have agreed to establish a bilateral working group to discuss such limitations. In testimony before the Subcommittee of the House International Relations Committee On October 26, Ambassador Marshall Shulman pointed out that we are now preparing proposals on this subject. President Carter has also recently stated that he expects negotiations on this topic to commence soon.²⁰⁸

What have been termed "preliminary discussions on anti-satellite systems" were conducted in Helsinki from June 8 through June 16, 1978.²⁰⁹ According to a U.S. Arms Control and Disarmament Agency release, these discussions between the Soviet Union and the United States addressed "questions in connection with limiting certain activities directed against space objects and incompatible with peaceful relations between states, including the means and systems for conducting such activities."²¹⁰ As in the case of other SALT and ABM related dialogue between the superpowers, no substantive information regarding the discussions has been made public. However, in view of the fact that at least second generation ASAT vehicles may rather prominently feature high-energy lasers as their destructive mechanisms, it is apparent that directed-energy weaponry is rapidly becoming a germane issue in the contemporary law of strategic arms control and may soon have to be addressed in this forum among others.

There also appears to be a third forum developing between the superpowers for the exchange of claims and counterclaims with respect to the control of directed-energy weapons. Ongoing U.S. and Soviet negotiations in Geneva aimed at developing weapons controls applicable to radiological weaponry appear

to have at least touched the issue of the particle-beam weapon if not the high-energy laser. Declassified information from the Carter administration's Fiscal Year 1979 Arms Control Impact Statements indicates that the Soviets have raised the issue of particle-beam weapons in these bilateral talks.²¹¹ The Soviets have reportedly advocated a ban on the development of particle-beam weapons which would be employed to affect "biological targets." The evolving U.S. response to the Soviet proposal is to define and deal with the particle-beam weaponry on a case by case basis. Relevant bilateral dialogue in radiological weapons talks is a strong indication that claims bearing on the control of directed-energy weapons are no longer merely theoretical, but are becoming matters of fact in the processes of developing the contemporary law of strategic arms control.

3. Claims Evaluation

The contemporary law of strategic arms control provides a limited institutional basis for claims asserting control of directed-energy weapons. Depending upon the scope of the Article II(1) definition of "ABM system," the ABM Treaty regime may apply directly to limit the development, testing and deployment of directed-energy weapons which are sea-based, air-based, space-based, or mobile land-based. However, as noted, this claim is subject to strong counterclaims and is perhaps reliable only to the extent that the superpowers have in fact specifically agreed to the inclusion of innovative weapons systems within the context of the Article II(1) definition.

The more persuasive and reliable claim arising out of the ABM Treaty stems from Article XII(2). This article provides a relatively concrete basis for a claim precluding the use of directed-energy weapons in a manner so as to interfere with national technical means of verification. A claim as to

impermissible use of either terrestrial or space-based directed-energy weaponry, whether based on HEL or PBW principles, against national technical means of verification would be persuasive. Although the Interim Agreement (SALT I) expired in May 1977, a similar and equally persuasive claim did exist until that time under that separate agreement. Claims under SALT I would have explicitly applied to satellite and other systems used for verification of offensive strategic arms, whereas the Article XII(2) provisions which still remain in effect only extend protection to verification mechanisms specifically applicable to ABM systems.

The strategic arms control law also affords important forums for broadening the institutional foundation for claims to the control of directed-energy weaponry. While it may be unclear whether the ABM Treaty actually limits the use of directed-energy weapons in an anti-ballistic missile mode, Agreed Interpretation [E] of the Protocol certainly provides an appropriate and logical means of resolving the issue if in fact there is no understanding between the superpowers. The Standing Consultative Commission appears an ideal forum for addressing issues such as the breadth of the "ABM system" definition under Article II(1) of the ABM Treaty. With respect to the specific issues involved in the possible use of directed-energy weaponry against satellites, the on-going ASAT discussions may afford a useful alternative or supplementary forum for the development of certain weapons controls. Finally the Geneva talks on the control of radiological weapons may be a useful forum for at least addressing the particle-beam weapon.

Claims as to impermissible use of directed-energy weapons founded upon these institutional bases would generally be expected to serve the exclusive and inclusive interests of the participants. To the extent that these various bases serve to protect a party's national means of verification from an attack launched by means of directed-energy weapons or other devices, the participant's

national security interests are enhanced. To the extent that the agreement serves to support and maintain the minimum public order and enhance the credibility of the nuclear deterrent, inclusive interests are served as well.

The enforcement mechanism supporting these institutions is a highly complex set of positive and negative sanctions. It is beyond the scope of this study to evaluate in detail either the reliability or credibility of all the sanctions which apply to the strategic arms limitation agreements. However, empirical evidence generally suggests that at least the ABM Treaty provisions have been observed by the superpower participants.²¹²

There are increasingly frequent claims that the Soviet Union has intentionally violated not only the spirit, but also the specific proscriptions of the SALT I Agreement.²¹³ Should these claims prove persuasive to U.S. decision-makers, it is likely that the ultimate sanction which will be applied in response, would be political rejection of the prospective SALT II Agreement. Such rejection in turn would further stimulate the superpower arms race, presumably to the disadvantage of both the sanctioning and sanctioned participants. However, in view of U.S. technological and economic capabilities, a rejection of SALT II would work to the particular disadvantage of the Soviets.

In summary, the institutional basis for claims seeking to limit the use of directed-energy weapons in the strategic arms control law is extremely narrow. Of particular significance in this body of law, is the existence of certain channels for the creation of appropriate and desirable arms control applicable to innovative weaponry. Whether and to what extent the law of arms control is amended to apply to directed-energy weapons will largely depend upon whether decision-makers perceive participant exclusive and inclusive interests advanced by such a step. For the present, it seems likely that the participants will find it beneficial to honor existing and relatively reliable institutional bases prohibiting the use of directed-energy weapons against national technical means of verification used to enforce the ABM Treaty. It is even

possible that these various bilateral institutions will eventually be expanded to provide a more pervasive foundation for claims to the control of directed-energy weaponry.

D. Comparative Evaluation of Claims

Three sets of institutional bases in the comprehensive international law applicable to the earth-space arena have been examined as potential sources for claims to the control of directed-energy weapons. Admittedly, the paucity of empirical case study material increases the vulnerability of any analysis of subject matter as innovative as this. Nevertheless, an examination of these bases coupled with a comparative analysis of their relevant arms control features yields certain preliminary conclusions regarding claims related to the impermissibility of directed-energy weapons.

None of the existing institutional bases has been developed for the purpose of controlling weaponry possessing the unique, innovative characteristics of the directed-energy instrument. Although the *travaux-preparatoires* are essentially unavailable for the various strategic arms control agreements, there is no indication that these institutions, any more than the Outer Space Treaty or general principles in the customary law were designed with the advent of directed-energy weaponry in mind. Moreover, there is no assurance that participants will expeditiously move to amend or reinterpret these institutions so as to develop meaningful or desirable controls for innovative weaponry.

Of the institutions considered in the comprehensive international regime, the contemporary strategic arms control law appears to offer the most promising set of bases for claims bearing on directed-energy weaponry. The ABM Treaty affords a basis for a very narrow claim prohibiting the use of directed-energy

devices against national means of verification. It may even extend to a limitation on the use of directed-energy weapons for certain kinds of anti-ballistic missile systems. Although the potential for expanding the scope of these limitations on weapons use exists in the ABM Treaty and Protocol to the Interim Agreement, the fact that the Soviet Union and United States have entered into independent "hunter-killer" satellite talks in Helsinki may indicate a proclivity toward the development of independent and specially tailored institutions expressly molded to cope with particular weapons problems.

The applicable customary international law principles suggest a strong disposition toward the use, exploration and eventual exploitation of space for exclusively peaceful purposes. There is also a general disposition toward banning nuclear or other weapons of mass destruction from certain areas in space. These principles, while formally incorporated in the Outer Space Treaty, are restrictively applied by major space resource states. Neither these key principles nor the arms control provisions of Article IV of the Outer Space Treaty have effectively discouraged the superpower participants from research, development, testing and even production of coercive instruments for use throughout the earth-space arena. Although it could be argued that the Treaty has served to control the orbital deployment of nuclear or other weapons of mass destruction, it appears the relative inefficiency of these instruments compared with the alternative ICBM delivery system is the actual motivation for participants keeping the near space theater free of such devices.

In those few instances where states have been forced to interpret and apply the general principles or arms control provisions in the earth-space arena, participants have tended to construe the international law narrowly so as to authorize at least the developed weapons systems. The preliminary Helsinki

ASAT talks reaffirm this propensity toward narrow construction of the principles and arms control provisions of the Outer Space Treaty. Participant exclusive interests in a strong national defense or, alternatively, inclusive interests in minimizing the chance of mutual assured destruction, have been instrumental in the space resource states interpreting the international law so as to authorize development and testing of the Fractional Orbital Bombardment System, the antisatellite interceptor and especially the ICBM's employed in strategic deterrence forces.

The utility of the general principles and the Outer Space Treaty as bases for claims to the control of directed-energy weapons is further reduced by impotent sanctioning mechanisms. Even if the relevant arms control concepts in these two institutions are expanded so as to apply to the control of directed-energy weaponry, participants are not apt to risk vital national security interests to an international law doctrine which offers no credible enforcement mechanism. In contrast, the law of strategic arms control tends to provide agreements based upon somewhat more concrete enforcement mechanisms which include authorized reconnaissance for verification of compliance and permissible unilateral withdrawal in the event of a serious breach by the other party. The arms control provisions implicit in the general principles or explicitly established in the Outer Space Treaty are too amorphously structured to provide for such concrete, credible sanctioning procedures.

Nothing prevents the amendment or reinterpretation of existing international law institutions specifically applicable to the earth-space arena. However, these institutions and others which might be examined do not in their present form support claims to prohibition of directed-energy weapons. With the exception of the prohibition on the use of directed-energy weapons against national means of verification of ABM systems and possibly in certain mobile ABM systems, these same institutions are ineffectual as a means of

controlling the research, development, testing, production, deployment or general use of such devices. The ongoing bilateral ASAT negotiations may produce a new institutional basis for controlling development, testing, deployment or use of antisatellite instruments including those which might be armed with directed-energy weapons. It is also possible the Geneva talks on the control of radiological weapons could result in constraints on a particle-beam weapon. If either of these agreements is specifically drafted to incorporate innovative weaponry, it may serve to place the first explicit controls on directed-energy weapons.

It should be noted however, that neither the ASAT or the radiological weapons talks were specifically established for the purpose of placing prohibitions or limitations on directed-energy weapons. If controls result, it will be an indirect consequence of bilateral efforts established for other purposes. Accordingly, it is almost certain that any such controls would be relatively narrow in scope excluding many of the possible strategic and tactical applications of the particle-beam weapon or high-energy laser.

The comprehensive international law applicable to the earth-space arena, at least in its present state, is largely an ineffectual means of controlling directed-energy weaponry. Ambiguity, narrow interpretation, unreliable sanctioning mechanisms and participant interests conspire to prevent application of these institutional bases for the purpose controlling this innovative weaponry. As bases for claims to reliable arms control over either the high-energy laser or particle-beam weapon, they are of limited utility. The existing arms control provisions in the comprehensive international law applicable to the expanded arena will do little to guarantee the stability, much less the enhancement, of the minimum world public order system.

IV

CONTROL OF DIRECTED-ENERGY WEAPONS

. THROUGH THE INTERNATIONAL LAW OF ARMED CONFLICT

The criteria for a weapon to meet the test of lawfulness may be summarized by stating that it must not cause a destruction of values disproportionate to the military advantage gained through its use. The historical experience in applying the criteria appears to indicate that weapons will be upheld as lawful except where there is great disparity between the ensuing destruction of values and the military advantage gained.

W. T. Mallison Jr.²¹⁵

To complete the analysis of prohibitions and limitations applicable to directed-energy weapons, it is necessary to examine the body of law specifically concerned with the conduct of armed conflict. Although this body of law has not been explicitly incorporated into the comprehensive international law applicable to the earth-space arena, the unqualified language found in Article III of the Outer Space Treaty²¹⁶ seems authority enough to firmly establish its universal application in all theaters; terrestrial as well as extraterrestrial. The preceding chapter examined a broad range of institutional bases in the comprehensive international law which might afford support to claims or counterclaims bearing on the control of directed-energy weapons. In contrast, the following survey of the international law of armed conflict will look instead to the relatively narrow body of doctrine which traditionally has

sought to impose constraints on the conduct of coercion. Again, this body of doctrine is best analyzed through its various institutional bases. These bases should be examined as a possible source of support for claims or counterclaims bearing on the control of directed-energy weapons in the earth-space arena.

Before proceedings, it is useful to understand the context in which these claims or counterclaims are made. Claims to weapons control in the law of armed conflict should not be confused with claims related to the permissibility or impermissibility of the use of force itself. In the minimum world public order system, claims bearing on the participant's right to resort to force are judged under criteria provided in Articles 2(4) and 51 of the United Nations Charter. Such right must also be evaluated in light of certain articles found in Chapters VII and VIII of the Charter authorizing participants to engage in limited enforcement actions.²¹⁷ Article 2(4) proclaims: "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations."²¹⁸ While Article 2(4) is designed to prohibit the use of force in international relations, Article 51 of the Charter nevertheless authorizes participants to exercise their inherent right of individual or collective self-defense if an armed attack occurs against them. Participants are also authorized to resort to coercion when acting pursuant to a U.N. or regional mandate under either Chapter VII or VIII for the maintenance and restoration of peace and security.²¹⁹

Regardless of whether a participant resorts to the application of coercion lawfully in accordance with the Charter or violates the provisions of Article 2(4), it is subject to constraints imposed by the law of armed conflict. Whether in the role of aggressor, defender or enforcement authority acting for the U.N. or some regional organization, each participant is subject to two fundamental rules. First, it may only attack legitimate objectives and

second, it may only apply permissible techniques in conducting its coercion. Under at least traditional international law, violation of either of these two fundamental rules subjects the participant to various sanctions which include among others holding responsible participant authorities accountable as war criminals.

Claims to weapons control tend to focus more on the second of these rules, to wit, the techniques or methods applied in the conduct of acts of coercion. Nevertheless, constraints as to lawful objects of attack relate to the participant's ability to direct its attack. To that extent, both fundamental rules are relevant in an examination of the legality of the directed-energy weapon in the law of armed conflict.

A. The Law of Armed Conflict as an International Regime

1. Principles and Collateral Concepts in the Customary Law

At the root of the international law of armed conflict are a set of established principles and collateral concepts which have a considerable bearing on claims relating to both the prohibition *per se* and limitation of weapons systems. These general principles and collateral concepts are construed by international law scholars in many generic classifications. While the classifications themselves may be of little significance to this study, the rationale upon which they are founded is important in analyzing the legality of prospective weapons systems. This rationale including its basic assumptions, is also important since it has frequently been incorporated into conventional regimes which purport to prohibit or limit weapons by means of certain general principles.

Professor W. T. Mallison Jr. considering the impact of the customary law on weapons control refers to the principle of "military necessity."

According to Professor Mallison,

Military necessity should be regarded as legalizing only that destruction which is necessary to the prompt achievement of lawful military objectives. More specifically, military necessity only justifies destruction which is relevant to the attainment of lawful military objectives and proportionate, in the sense of a reasonable relation between the amount of the destruction carried out and the military importance of the object of attack. Based upon past experience, the requirements as applied in actual war or hostilities are only that the irrelevance and disproportionality of the destruction effected must not be great.²²⁰

Basic to the principle of "military necessity" is the concept of proportionality. One authority which perceives "proportionality" as a principle separate in itself observes "acts of war must be based upon a balanced relation of the means employed to a military end. The means cannot exceed the end."²²¹ Striking this balance as to whether a means or technique is reasonable in achieving the end is typically accomplished by an application of a "reasonable man standard."

A recent unilateral interpretation of the principle of military necessity is offered by the U.S. Air Force in its publication AFP 110-31, *International Law-The Conduct of Armed Conflict and Air Operations*: "Military necessity is the principle which justifies measures of regulated force not forbidden by international law which are indispensable for securing the prompt submission of the enemy, with the least possible expenditures of economic and human resources."²²² The Air Force definition assumes that the force applied by the participant is controllable and that its use is essential to achieve an expeditious submission of the opponent. It also incorporates the concept of proportionality to the extent it justifies measures indispensable

for securing prompt submission of the enemy (the end) with the least possible expenditure of resources (the means). It further assumes that it is possible to ascertain whether or not a measure is forbidden by the international law. Both conceptualizations of the principle of military necessity establish the import of the relationship between the techniques invoked by the participant and the objective to be achieved. Moreover, they emphasize this relationship is dependent upon certain facts which it is assumed are ascertainable. The difficulties in applying the principle of military necessity stem in large part from these assumptions that certain facts are ascertainable.

A second general principle basic to the law of armed conflict is that of "humanity." Humanity is perceived as mutually exclusive from, but nevertheless complementary to, the principle of military necessity. As formulated by the Air Force AFP 110-31, the principle of humanity "forbids the infliction of suffering, injury or destruction not actually necessary for the accomplishment of legitimate military purposes."²²³ Again there is an element of "proportionality" to the extent that the adverse effects of coercion are not to overreach the lawful military purpose. Under this principle, it is generally assumed that civilians or noncombatants should not be lawful objects of attack. This immunity does not preclude unavoidable casualties occurring during attacks against authorized military objectives. However, such unavoidable casualties under the principle of humanity cannot be excessive in relation to the projected military advantage to be gained.²²⁴

Certain assumptions and ambiguities are apt to cause difficulty in the application of this principle. The principle assumes that participants are able to ascertain what adverse effects are "necessary" for attaining the desired end. It also assumes that the desired end of "legitimate military purpose" is equally ascertainable.

As is apparent, both principles share a tendency to be open-ended.

Both are also firmly rooted in the protection and preservation of key participant human and material values. With regard to the rationale supporting these complementary principles, Professor Mallison observes:

Both basic principles, . . . protect important value interests of the world community. Until war and hostilities are abolished, the basic principles reflect the interest of states in conducting war or hostilities (at least for defensive purposes), but in conducting them with the least possible destruction of human and material values. It is wanton and unreasonable destruction which is made illegal by the principles of military necessity and humanity.²²⁵

Professor Mallison suggests that there is a point in the conduct of armed conflict where an increased level of applied destruction and violence is counterproductive for all participants, no matter what their role or position. To carry the conduct of armed conflict beyond this point is illogical, irrational, and in violation of the basic premises of the international law of armed conflict.

The significance of these principles is that they provide juridical criteria for determining the legality of particular weapons. In this function, the principle of military necessity tends to prevail over the principle of humanity when the two are in apparent conflict. In consequence, weapons are considered as lawful to the extent that the destruction of resources and personal injury they produce is absolutely necessary to the attainment of the military objective. In specifically addressing the legality of innovative weapons systems, Professor Garner notes:

The employment of new and powerful inventions of destruction or of new methods is, of course, not to be condemned and ruled out merely because they are new or because they are more effective than those formerly employed, as a few sentimentalists in every age have wished to do. The true test of their lawfulness is rather whether they can be employed without inflicting superfluous injury upon those against whom they are employed, whether they 'uselessly aggravate the suffering of disabled men,' whether their effect is cruel and inhumane, and the like. ²²⁶

A generally consistent perspective which invokes the concept of proportionality common in both principles is offered by Professors McDougal and Feliciano:

The permissible or nonpermissible character of the employment of a particular weapon or mode of attack has in broad principle been made by decision-makers to turn upon the proportionality between the deprivation of values incidental to the use of the weapon or mode of attack and the military advantage accruing to the belligerent user. (O)nly weapons whose use has resulted in incidental value deprivations obviously superfluous and grossly disproportionate to the ensuing military advantage have been characterized as nonpermissible and effectively outlawed. Since such weapons are by definition militarily inefficient-value deprivations necessitate the expenditure of force - the compromise in favor of military necessity is obvious.²²⁷

Professor Mallison more concisely summarizes the criteria for a weapon to meet the test of lawfulness by simply stating "it must not cause a destruction of values which is disproportionate to the military advantage gained through its use."²²⁸

Although military necessity and humanity form the two fundamental principles of the law of armed conflict, other bases have also been suggested for providing juridical criteria used in appraising the lawfulness of weapons. Although in certain instances these principles or collateral concepts may be seen to be adjuncts to or component facets of military necessity and humanity, certain attributes may tend to vary from the fundamental principles. A principle which is occasionally mentioned but considered of relatively little contemporary value is "chivalry." Chivalry as a principle demands armed conflict be conducted in accord with certain established, traditionalistic formalities and courtesies. Twentieth Century warfare and the advanced technology which may produce destructive effects well separated in time and space from the belligerent using a particular weapon has tended to diminish the impact of this principle.²²⁹ The principle is still applicable with respect

to prohibitions against the use of poison, dishonorable or treacherous misconduct, misuse of enemy flags, and other types of perfidy. But with few exceptions, its applicability to weapons control is marginal.

A set of collateral concepts or principles of considerably greater relevance to contemporary problems of weapons control has been proffered by the Stockholm International Peace Research Institute (SIPRI).²³⁰ Entitled "progressive principles," these concepts have been employed by SIPRI in its analysis of various innovative weapons systems which it refers to as "dubious weapons." SIPRI contends that the fundamental or traditional principles in the law of armed conflict are not always adequate as measures with which to analyze these new dubious weapons. Although neither the particle-beam weapon nor the high-energy laser are specifically included in SIPRI's detailed analysis of dubious weapons, it would appear these progressive principles are designed for general application to contemporary or innovative weapons of modern warfare.

The principle of survival as proffered by SIPRI seeks to delimit the bounds of military necessity to the extent that when the very existence of mankind itself may be at stake due to coercive action, military necessity must yield, even if the self-preservation of the participant state is placed in jeopardy. Implicit in the principle is the concept that at least some weapons of mass destruction now possessed by participants, if used in massive or general coercion, would have major effects on noncombatant participant states and the world community as a whole. As some evidence of support for such a principle, the SIPRI study cites U.N. General Assembly Resolution 1653 (XVI) of November 24, 1961 in which all use of nuclear weapons is condemned as "a crime against mankind and civilization."²³¹ The resolution notes that such weapons were directed against not only belligerents, but also "against mankind in general." While the progressive principle of survival may be of little value

in actually constraining belligerent actions in cases of massive coercion, it may present a useful criterion for appraising which weapons systems should be developed while states are still at peace. In other words, while some level of rationality prevails, participants may consciously opt for systems which are less apt to place the survival of mankind in jeopardy in the event war does occur.

The SIPRI study cites other examples of progressive principles which it asserts are gaining acceptance in the international law of armed conflict. It is suggested that a principle of "environment" may be evolving which looks to the ecological impact of a particular weapons system. While the exclusive and inclusive participant interests in supporting an optimum natural environment have been well recognized in the general international law, the law of armed conflict is only now beginning to incorporate the concept as a juridical criterion.²³² As noted by the SIPRI study:

Responsibility for the environment is recognized in the modern international law of peace. It should also be recognized in times of war. The value of 'the environment' and the importance of its preservation should be recognized as belonging to the factors which should be taken into account in deciding upon the laws of war concerning 'dubious weapons'. Less need to do this existed in former times. At present, new weapons have become available which threaten the human environment in its integer biological existence, and technological developments may bring about the possibility of causing fundamental changes in the earth's ecology. The time is ripe to brand specific acts as international crimes of 'ecocide'. The laws of war should be adopted to this new situation.²³³

Here, there is no suggestion that the inclusive interests in value conservation implicit in this principle would prevail over the principle of military necessity. However, participants developing alternative weapons systems each exhibiting comparable destructive and operational efficiencies, may well opt for the system which least impacts upon the environment.

The third progressive principle suggested by the Stockholm Institute as a means of appraising the legality of dubious weaponry is referred to as the principle of "threshold."²³⁴ The SIPRI study observes that there is a clear threshold between certain weapons of mass destruction, *e.g.* thermonuclear devices, and conventional weaponry. This threshold is sufficiently visible to the participants and the threat of mutual assured destruction of values so clear, that in an armed conflict, rational combatants will tend to avoid the first use of the more demolitionary weapons of mass destruction for fear such action would open the door to further use. In the case of the threshold between conventional and nuclear weapons, the Stockholm Institute's study observes, "If this threshold is trespassed, the road is open to the use of all nuclear weapons."²³⁵

The principle of threshold is based on at least two relatively weak and generally unsupported assumptions. First, it assumes that weapons of mass destruction are by their very nature less desirable as instruments of coercion than conventional weaponry. It assumes that in any armed conflict that weapons of mass destruction are necessarily apt to bring about greater deprivation of participant values than conventional weaponry. The principle further assumes the absence of significant thresholds within a given class of weapons of mass destruction.²³⁶ These assumptions have been attacked as unsubstantiated in fact by a number of authorities with particular reference to prohibitions on chemical devices.²³⁷

Although it is beyond the scope of the present analysis to evaluate these arguments, suffice it to say that there is a strong case that there are weapons which, because of the physical principle upon which they are based, are classified as weapons of mass destruction despite the fact they may be nonlethal, controllable and relatively discriminating. Such weapons may be rather clearly distinguishable from other weapons employing the same general physical principle.

In certain instances, this distinction may be so apparent as to ensure the existence of a threshold within the class of weapons itself. Such an intra-class threshold might function equally well to discourage the use of the more devastating devices in the class while nevertheless permitting the use of the more discriminating, controllable weapons which operate on the same physical principle. A typical example cited by the proponents of this argument would be the nonlethal gases, *e.g.* tear gas, which are considered within the classification of gas or chemical devices and accordingly placed in the category of weapons of mass destruction. Clearly such categorization appears illogical.

The paramount significance of both the traditional and evolving body of progressive principles is that they provide a set of juridical criteria for evaluating innovative weapons systems. When examined carefully, some of these principles may be based upon assumptions which are not necessarily universally valid. However, as long as these assumptions are recognized and their limitations acknowledged, the resultant criteria may be invoked as potential institutional bases supporting claims to weapons control.

The preeminent point which seems lost to many who would apply the criteria suggested by these principles, is that their greatest utility may be in offering standards upon which comparisons may be made. An appraisal of the lawfulness of a particular weapon in terms of these various principles, both fundamental and progressive, is apt to ignore the influence of alternative devices in reaching a decision as to legality of any given system. A narrow analysis of an isolated weapons system may also fail to consider competitive political, diplomatic or military strategies impacting on factual conditions in the real world arena. At least until such time as the optimum world public order system is effectively attained, the lawfulness of innovative weaponry

must be judged in terms of a comprehensive analysis which examines alternative devices within the context of real world strategies.

2. General Weapons Control in the Early Conventional Law

An accurate juridical analysis of directed-energy weaponry presupposes some understanding of how the general principles have been applied in the historical context. It is not the purpose of the present study to exhaustively examine the considerable historical experience concerning the prohibition *per se* or limitation of weapons. Nevertheless, a selected examination of this historical experience with a particular emphasis on the efforts to control weapons through international convention affords a broad perspective from which to apply juridical criteria to directed-energy devices. Moreover, the historical experience aids in understanding how the customary law principles are applied and interpreted in conventions which might serve as general institutional bases for claims related to the control of directed-energy weapons.

The recent experience in weapons control finds its genesis in the Declaration of St. Petersburg of 1868. Convoked by the Russian Imperial Government in 1868, the "International Military Commission" addressed itself to the problem of certain newly developed projectiles which were explosive or contained "fulminating or inflammable substances."²³⁸ The Russian Government was concerned that the smaller of these projectiles, those less than 400 grammes, tended to cause excessive injury to individual combatants when compared with the preexisting alternative, the non-explosive bullet.²³⁹ In prohibiting the use of such projectiles, the Declaration invoked concepts which have become fundamental precepts in the law of armed conflict vis-à-vis weapons control:

That the only legitimate object which States should endeavor to accomplish during war is to weaken the military forces of the enemy;

That for this purpose it is sufficient to disable the greatest possible number of men;

That this object would be exceeded by the employment of arms which would needlessly aggravate the sufferings of disabled men, or render their death inevitable;

That the employment of such arms would, therefore be contrary to the laws of humanity;

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This language expresses the clear desire of the Commission to place certain general constraints on the conduct of armed conflict, particularly with regard to the use of certain arms which evoke adverse and unnecessary effects. Although the United States and many other states did not participate in the formulation of this proclamation, it is today generally regarded as part of the customary international law of armed conflict.

It is clear from the language of the Declaration that the Commission considered the criteria of military necessity and humanity in appraising the legality of the innovative explosive bullet. What the St. Petersburg Declaration also suggests is that the juridical determination of illegality was at least in part a consequence of the availability of an efficient alternative instrument of coercion that accomplished the same end without the same adverse effect upon its targeted victims. Military necessity simply did not demand the use of an explosive or fulminating bullet to disable or kill individual field soldiers.

When World War I demonstrated the military advantages of aerial warfare, participants exhibited no compunction in reintroducing the explosive bullet.²⁴¹ However, in this instance the explosive bullet was employed against aircraft and not the footsoldier. In the context of World War I aerial warfare, the same principles of military necessity and humanity implicit in the St. Petersburg Declaration of 1868, served equally well to render permissible the same weapon in a different set of circumstances. In each case, participants

compared the relative efficiencies and impact of alternative weapons in the context of the military mission and reached opposite results. Yet in each instance, the operative principles were at work and affected the juridical analysis of the weapon.

When the European delegates met at the Hague Conference of 1899, a principal topic of discussion was the use of the balloon to launch projectiles or explosives. The participants reached agreement "to prohibit, for a term of five years, the launching of projectiles and explosives from balloons, or by other new methods of a similar nature."²⁴² Again the principles of military necessity and humanity were implicit in participant efforts to limit use of the lighter than air vehicles. As of 1899, no participant state had produced an especially efficient lighter than air vehicle suitable for carrying on accurate aerial bombardment. However, the interim nature of the agreement was a clue to participant expectations that a future comparison of the lighter than air vehicle with conventional delivery systems might yield very different results.

Since the Hague Declaration did not restrict research and development, participant states continued efforts to produce a militarily efficient lighter than air vehicle. By the time the Hague Conference of 1907 convened, the major Continental powers had active airship development programs and were not inclined toward a renewal of previous restrictions on these potentially efficient delivery systems.²⁴³ The airship, unlike previous ground delivery systems, could operate at altitudes beyond the reach of ground defenses making it essentially immune from defensive attack. Moreover, it could deliver a substantial explosive payload to a distant target with increased accuracy. Bombardment well beyond the enemy's front lines using something other than naval combatants was now for the first time a viable possibility. Although

participant states which considered their geographical vulnerability increased by the dirigible or which had no development programs of their own favored renewal of restraints on aerial bombardment, the prospective efficiency of this innovative delivery system ensured it lawful combatant status.²⁴⁴

The experience surrounding attempts at weapons control by the two Hague Conferences suggests the existence of an important juridical factor which is highly influential, if not controlling, in the evaluation of weapons systems. Dr. M. W. Royse in addressing efforts at the Hague Conferences to regulate weapons systems posited this thesis:

Such destructive weapons, for instance, as the high explosive shell, the shrapnel, mines or torpedoes, were retained as legitimate means of warfare, whereas the inefficient expanding and explosive bullets were condemned along with the perfectly useless free balloons. *The proceedings of the Hague Conference(s) demonstrate rather that a weapon will be restricted in inverse proportion, more or less, to its effectiveness; that the more efficient a weapon or method of warfare the less likelihood there is of its being restricted in action by the rules of war. (emphasis added)*²⁴⁵

Recalling the historical experiences with aerial bombardment and events which resulted in the authorization of the submarine warship, Professor Mallison acknowledges the Royse thesis, observing, "Thus in the present century combatant units which have been found to function with military efficiency in relatively new warfare environments, the air and under the sea, have been accorded lawful status."²⁴⁶

The Royse thesis might well be questioned in view of the selected achievements in both bilateral and multilateral arms control negotiations since World War II. Any of a number of international agreements have been reached which would appear to control relatively efficient weapons systems.²⁴⁷ However, as noted in the preceding chapter, the general tendency is to interpret the arms control provisions of such agreements narrowly so as to

authorize those activities or weapons not expressly prohibited. In instances where there has been progress toward controlling potentially efficient systems, it appears that either one of the progressive principles acted to influence the juridical determination or a relatively credible sanctioning system was developed in support of the conventional prohibition or limitation.²⁴⁸

Experience since the advent of weapons of mass destruction suggests that the Royse thesis-contending efficient weapons will be deemed lawful-can not be applied in a wooden fashion without a careful examination of the facts. However, it is difficult to lightly dismiss the factual evidence that Royse and others subscribing to his thesis bring to bear when discussing the historical experience in testing weapons legality under the international law of armed conflict.²⁴⁹ The thesis seems to emphasize that any juridical analysis of a weapon should take into account its relative efficiency when compared with other competitive instruments of coercion. The efficiency of an innovative weapon may actually be such as to enhance participant claims to its authorized use on the basis of the principles of military necessity and humanity. To the extent the efficiency of the weapon permits prompt submission of the enemy with minimum expenditures of resources and at the same time aids in achieving the legitimate military purpose with minimum unnecessary suffering, it serves to enhance claims based on these two fundamental principles.

While the Hague Convention of 1907 produced few if any meaningful limitations with regard to efficient weapons, it nevertheless articulated two important general precepts bearing on weapons control. Article 22 of the Annex to the Hague Regulations for Convention IV provides "The right of belligerents to adopt means of injuring the enemy is not unlimited."²⁵⁰ This pronouncement, while certainly imposing no concrete constraints on any particular or even general category of weapons, generally supports the limitations implicit in the

fundamental principles. It establishes a very broad conventional rule for restraining the means, conduct and weapons employed in armed conflict.

Article 23(e) of the Annex to the 1907 Hague Regulations provides a second precept bearing on weapons control. This provision states in pertinent part: "In addition to the prohibitions provided by special Conventions, it is especially forbidden- . . . To employ arms, projectiles, or material calculated to cause unnecessary suffering."²⁵¹ This general conventional rule, while again implicitly incorporating the concepts of military necessity and humanity, specifically proscribes instruments of coercion which produce "unnecessary suffering." To some extent, Article 23(e) represents a reaffirmation of the St. Petersburg Declaration which sought to bar the use of particular weapons which "uselessly aggravate the sufferings of disabled men, or render their death inevitable."²⁵² In determining which weapons or methods of warfare are barred *ipso jure* under Article 23(e), international law looks to the practice of states. As noted in AFP 110-31:

What weapons or methods of warfare cause *unnecessary suffering*, and hence are unlawful *per se*, is best determined in the light of the practice of states. All weapons cause suffering. The critical factor in the prohibition against unnecessary suffering is whether the suffering is needless or disproportionate to the military advantages secured by the weapon, not the degree of suffering itself. 253

The doctrine of the avoidance of unnecessary suffering articulated in Article 23(e) has been repeatedly invoked in the international law of armed conflict. It was central to the prohibition of dum dum or exploding bullets.²⁵⁴ It has also been cited as the rationale behind prohibitions against the use of projectiles filled with glass or materials inherently difficult to detect medically. This doctrine is construed so broadly that it seeks to proscribe not only weapons and methods which cause unnecessary suffering, but

also the manner in which they are employed against combatants.²⁵⁵ In other words, a weapon may meet the criteria established under Article 23(e) by exhibiting characteristics which do not tend to cause unnecessary suffering, yet nevertheless be regarded as unlawful because it is employed in a manner apt to bring about the same proscribed result.

3. The Impact of Modern Warfare

Understanding the general application of the customary law principles and certain key provisions in the early conventional law of weapons control, it is now important to consider the impact of modern warfare on the law of armed conflict. The general customary law principles and the early conventional regimes were developed to deal with forms of armed conflict and weapons largely of a previous era. While in practice they have been applied frequently in the Twentieth Century, they have not been consistently effective or relevant in addressing new modes of combat, weapons or participant strategies. Since the directed-energy weapons are distinctly innovative products of the contemporary era, the major influences of modern warfare upon the international law of armed conflict must be considered for purposes of the present juridical analysis.

Perhaps one of the most significant factors of modern warfare to influence the law of armed conflict is the development of weapons of mass destruction. Some of the earliest weapons of mass destruction were the asphyxiating, poisonous and other land warfare gases. The delegates to the Hague Conference of 1899 were apparently concerned about these gases and sought to impose restraints on their use. Nevertheless, gas warfare became prevalent in World War I after Germany initiated its use in 1915 as an instrument of anti-trench warfare.²⁵⁶ The development of these early gases was followed by research into bacteriological agents. In the hope of discouraging at least the

first use of these early weapons of mass destruction, a number of major power participants developed the Geneva Gas Protocol of 1925.²⁵⁷ Despite considerable criticism of its weak enforcement mechanisms, the Protocol remains in effect and has been recently ratified by the United States.²⁵⁸

Even more significant than the introduction of these early chemical and bacteriological agents was the advent of the atomic bomb toward the end of World War II. With the success of the U.S. Manhattan Project and the subsequent surrender of the Imperial Japanese Government brought about by the August 1945 bombings of Hiroshima and Nagasaki, the world was wrenched into the nuclear age. Since these initial catastrophic events, nuclear weapons technology has been achieved by a variety of states. Moreover, the numbers and sophistication of nuclear and thermonuclear devices has expanded dramatically, particularly in the case of the superpowers and their most powerful military allies.

The development of these and other weapons of mass destruction has greatly influenced participant strategies. These weapons and the sophisticated rapidly delivery systems which have been developed in conjunction with them have made it possible to strike a single devastating blow to an adversary. As a result, participant military and political strategies have dramatically changed. Whereas in earlier periods, the objective of participant state military action was often dominance over a set objective, the current era is more apt to be characterized by more restrained goals, at least in the case of the nuclear powers. The growth of massive arsenals of sophisticated thermonuclear and nuclear weapons along with strategic force delivery capability has often tended to check the military options which might have been previously available to participants. As observed by the Stockholm International Peace Research Institute (SIPRI):

Although dominance is still an objective in relations between the great powers and the small states, in their sphere of influence or

outside that sphere, or among small powers (for example, the conflict between Israel and the Arab countries), this objective has almost disappeared in relations among the great powers. If NATO and the Warsaw Treaty Organization (WTO) were to wage all-out war, the question of victory would have little meaning since such a conflict would result in mutual destruction before the issue of who was the stronger could be settled.²⁵⁹

The principal role of weapons of mass destruction and in particular, nuclear and thermonuclear devices, has been in support of the strategy of deterrence, to wit, preventing the outbreak of war through the threat of massive retaliation in the event of an armed attack. To amplify the threat against a potential aggressor, deterrence has been construed to authorize attacks upon not only military objectives traditionally authorized by the general principles, but also civilian population centers as well.²⁶⁰ To ensure the credibility of the strategic deterrence forces against a disarming preemptive first strike, the superpower participants continually upgrade and improve upon sophisticated delivery systems which are operationally deployed so as to guarantee effective retaliation even in the event of the feared preemptive strike. The policy of guaranteeing a massive retaliatory strike by each superpower against the other in the event of an attack is euphemistically referred to as "mutually assured destruction" or "MAD."

In circumstances where the strategy of deterrence influences participant actions, it supersedes both the traditional, and in most cases even the progressive, principles of the law of armed conflict. For example, in order to ensure the success of deterrence, the ABM Treaty actually increased the exposure of otherwise protected noncombatants in participant states to potential nuclear attack. The rationale for this apparently unlawful or at least illogical bilateral agreement was to guarantee the credibility of the nuclear deterrent and effectively enhance the existing "balance of terror" to discourage a preemptive strike. The premise of the ABM Treaty is that defensive means

against nuclear retaliation directed against civilian population centers must be limited so as to ensure the continued credibility of retaliatory deterrence weapons.²⁶¹

Another influence which must be taken into account in any juridical analysis of innovative weapons, is the Twentieth Century concept of unrestricted warfare. This influence, like the advent of weapons of mass destruction and the theory of nuclear deterrence, has tended to decrease the impact of the fundamental principles on warfare. The concept of unrestricted warfare entails combatants attacking the aggregate power bases of the enemy state including; the military establishment, the transportation system, the economic structure, the ideological foundations, social organization and the population itself. The objective of the strategy is to dismember key components of the opponent's institutional power bases making further conduct of the conflict increasingly more costly and difficult. In its extreme, such strategy involves either direct attacks upon civilian population centers, or alternatively, substantial ancillary destruction and injury to such noncombatants by virtue of massive assaults on otherwise legitimate targets in the vicinity.

During the American Civil War, General Sherman invoked the strategy of total or unrestricted warfare against the Confederacy in his infamous march through Georgia. Said Sherman, "The only possible way to end this unhappy and dreadful conflict . . . is to make it terrible beyond endurance!" General Sheridan operated on the same premise in conducting unrestricted warfare against the American Comanche Tribe.²⁶² The strategy of unrestricted warfare was exercised to a limited extent in World War I. However, with the development of the medium and long range bomber, high explosive ordnance and fire bombs, submarines of greatly increased operational capabilities, and many equally lethal weapons, most combatant states were exposed to the full force of this strategy by the onset of World War II. The German V-1 and V-2 attacks on England,

the London blitz, the fire bombing of Dresden and Japanese cities and ultimately the atomic bomb attacks themselves exemplified some of the worst horrors inherent in the strategy of unrestricted warfare as practiced during the World War II.²⁶³ It is apparent in all these actions that noncombatant civilians were the real victims of the attacks designed to increase the "price" each participant paid for its continued involvement in the conflict.

Superpower and major power participant state military strategies since World War II have generally continued to embrace the concept of unrestricted warfare. The principal qualification to this policy has been with regard to the use of weapons of mass destruction. The use of weapons of mass destruction and in particular nuclear or thermonuclear devices has been avoided largely by reason of the threshold principle — that is a fear that the first use of these devices will dangerously escalate the conflict to a level of massive coercion in which there would be unrestrained exchanges of such weaponry among participants. Both the North Vietnamese attacks on the Republic of South Vietnam and the American conduct of the war against North Vietnam displayed at least some characteristics of the strategy of unrestricted warfare. Although the U.S. aerial war against North Vietnam was by no means totally unrestricted, one of its objectives was nevertheless to bring the war to the civilian population and weaken the country's total capability to wage an aggressive war against the Republic of South Vietnam.²⁶⁴ However, a concern for the threshold also appeared to have been a major reason that the principal nuclear power participant, the United States, avoided the use of even tactical nuclear devices during the course of the prolonged conflict.

Soviet military strategy also embraces concepts of unrestricted warfare. Marshall V.D. Sokolovskiy in addressing the implications of weapons of mass destruction in a world arena characterized by conditions of political struggle

proclaimed: "Under these conditions, the political aims of the sides in a future world war will be achieved not only by the defeat of the armed forces, but also by complete disorganization of the enemy economy and lowering of the morale of the population."²⁶⁵ Although there is less evidence that the strategy of unrestricted warfare is pursued by the less powerful states, any apparent restraint on their part is probably more a function of lack of capacity to conduct such warfare and concern for major power intervention than an altruistic rejection of the policy itself.

By invoking an extremely broad interpretation of the principles of military necessity and humanity, it is possible to justify unrestricted warfare in terms of international law. The argument can be made that unrestricted warfare is justified as necessary to attain the military objective and that the force employed is proportionate to the military importance of the objective. Moreover, the force used is necessary for the submission of the enemy with the least expenditure of time, life and physical resources. Such an argument appears premised on the assumption that the lawful military objective is broadly interpreted to include the very submission or surrender of the enemy itself. There is a growing body of empirical evidence however, which suggests unrestricted warfare is based on an erroneous assumption that the application of coercive measures against the totality of the enemy's power bases necessarily produces a more expeditious and efficient termination of the conflict. A careful review of strategic bombing conducted during World War II now suggests unrestricted warfare may do little to bring about the early termination of the conflict and may even have the opposite effect through increasing the opponent's will to resist.²⁶⁶

B. A Framework for Analysis

Historically, the introduction of innovative weapons or methods of warfare resulted in denunciation of the cruel effects of the weapon. Pope Innocent III issued a decretum forbidding the use of the crossbow, arbalest and siege engines against Christians.²⁶⁷ The Second Lateran Council of the Roman Church (1139) enunciating its self-righteous concern for the then innovative crossbow, denounced it as "hateful to God and unfit for Christians."²⁶⁸ In referring to these and other examples, Professors McDougal and Feliciano observe:

While these examples may seem quaint today, they illustrate the natural tendency of those whose expectations are shattered by 'technological surprise' to denounce as 'cruel,' 'inhuman,' and 'illegal,' and to seek to outlaw, the new and unfamiliar weapon. Yet clearly novelty in itself cannot rationally be equated with illegality.²⁶⁹

It is clear that such simplistic denunciations or declarations have now become meaningless in an era characterized by the major influences of modern warfare.

The advent of modern warfare requires a more sophisticated framework of analysis which examines a triad of institutional bases relevant to arms control in the international law of armed conflict. An analysis and appraisal of claims bearing on the control of innovative weapons must first consider the customary law principles within the historical context. It must look to convention and the applicable practice of states. However, it must also consider important modifications and supplementary progressive concepts which address the influences introduced by modern warfare. Accordingly, innovative weapons including directed-energy devices must be analyzed in terms of the established conventional and customary law as well as the more recently postulated SIPRI progressive principles of survival, environment and threshold. While norms implicit in these principles may be far from established in the international law of armed

conflict, they do seem to bring important new criteria to bear which are particularly responsive to the problems posed by the introduction of weapons of mass destruction in an arena where the strategies of deterrence and unrestricted warfare are widely accepted.

A second institutional basis in the law of armed conflict which must be evaluated as a possible source for claims bearing on the control of directed-energy weapons looks to analogous experiences. An examination of analogous experiences, either in terms of weapons systems themselves or methods of warfare which in general exhibit similar destructive characteristics may offer valuable precedents as to the permissibility or impermissibility of directed-energy devices. Equally important, this mode of analysis may allow new weapons to be judged on a relative basis against existing weapon systems. This mode of analysis has the dual advantage of not only subjecting the new weapon to examination, but also imposing a further legal review upon the existing comparable system. In effect, the existing system must be justified in light of technological developments incorporated into the innovative system. An analysis should not dismiss the possibility that the innovative weapon may fare better in such a juridical analysis than the existing system because of improved efficiency, controllability or precision characteristics.

Finally, an improved framework of analysis for evaluating the legality of new weapons systems, must take into account claims based on any explicit treaty or conventional regime which may offer relevant weapons control. As noted in the preceding chapter, the comprehensive international law applied in the earth-space arena, including the law of strategic arms control, does little to prohibit or limit directed-energy weaponry. Nevertheless, certain recent developments in the international law of armed conflict suggest that conventional control mechanisms may be evolving which will potentially affect the legality of

innovative weapons. Although these developments may not have achieved the status of established international law, they must nevertheless be considered as possible sources for claims to the control of directed-energy weapons.

In conducting its reviews of prospective weapons systems, the U.S. Department of Defense applies a somewhat similar framework of analysis. As noted in AFP 110-31,

A weapon or method of warfare may not be considered illegal solely because it is new or has not previously been used in warfare. However, a new weapon or method of warfare may be illegal, *per se*, if it is restricted by international law including treaty or international custom. The issue is resolved, or attempted to be resolved, by analogy to weapons or methods previously determined to be lawful or unlawful. In addition to analogy, the legality of new weapons or methods of warfare is determined by whether the weapon's effects violate the rule against unnecessary suffering or its effects are indiscriminate as to cause disproportionate civilian injury or damage to civilian objects. The military advantages to be secured by use of the weapon must be compared with the effects caused by its use.

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With the exception of considering the supplementary progressive principles, the Air Force formulation for juridical analysis of new weapons incorporates the same triad framework suggested by this study. It would examine international law in terms of custom and treaty, analogous weapons systems and apply certain general principles of the law of armed conflict.

As the three bases of this analytical triad are applied, it is advisable to weigh one additional variable. While the era of modern warfare has made massive deprivation of values a possibility in armed conflict, it does not follow that all armed conflict necessarily results in massive deprivation of values nor that such conflict will ultimately be escalated to such an extent. One has only to recall the recent conflict in Southeast Asia to observe that the mere possession of weapons of mass destruction, adherence to a strategy of deterrence and the capacity for conducting unrestricted warfare, do not guarantee that all participants will pursue these policies in the conduct of their coercive

actions.

The question which arises is whether the criteria and their application are apt to vary as between circumstances of massive as opposed to limited coercion. As suggested, superpower and major power participant states appear to have introduced certain self-serving exceptions to the international law of armed conflict with respect to nuclear weapons systems.²⁷¹ These exceptions appear to have been introduced to parry claims that possession, deployment and use of strategic or tactical nuclear weapons constitute a violation of international law. The effect of these exceptions seems to have been to supersede the fundamental principles of the law of armed conflict on the theory that deterrence forces and the possession of tactical nuclear devices effectively enhances the maintenance of international peace and discourages massive aggression.

In juridically evaluating directed-energy weapons, the nature of the coercion should be considered and the question asked to what extent its scope may impact upon the lawfulness of attacking particular objectives. It is also necessary to inquire as to whether the scope of conflict may affect the legality of the methods employed or the manner in which weapons are used. Moreover, the fact that otherwise unlawful methods are authorized against protected objects of attack through current policies influencing the conduct of modern massive warfare, may prove an important factor in a comparative analysis of alternative strategic weapons systems. It should be understood that when the scope of conflict is examined as a variable, massive coercion will be distinguished from limited coercion by the assumption that in the former, participants either invoke or threaten to invoke weapons of mass destruction, possible massive retaliatory strikes or unrestricted warfare on a broad international scale.

C. Application of Controls in the Existing Customary and Conventional Law

1. Claims Based on Fundamental Institutions

In applying the fundamental principles of military necessity and humanity it is helpful to recall the juridical criteria distilled by Professor Mallison when he observed "for a weapon to meet the test of lawfulness . . . it must not cause a destruction of values disproportionate to the military advantage gained through its use."²⁷² In placing his criteria in perspective, Professor Mallison notes, "The historical experience in applying the criteria appears to indicate that weapons will be upheld as lawful except where there is a great disparity between the ensuing destruction of values and the military advantage gained."²⁷³ These operative criteria essentially parallel the measures propounded by AFP 110-31 which would examine whether the weapon violates the rule against unnecessary suffering contained in Article 23(e) of the Annex to the Hague Regulations of 1907, or alternatively, whether its effects are indiscriminate as to cause disproportionate civilian injury or damage to civilian objects.²⁷⁴

In specifically applying this criteria, the initial query is whether the innovative weapon is capable of accurately delivering its coercive force to the target.²⁷⁵ Most indications are that directed-energy weaponry when operational, will possess targeting accuracy essentially limited only by the precision capabilities of its optical or radar guidance systems. In addition, directed-energy weaponry by reason of its physical principle may be designed so as to prevent the commencement of destructive continuous wave or pulse energy until such time as guidance systems have firmly locked onto the target and accurate acquisition is confirmed. Presumably such target acquisition checks and failsafe firing mechanisms would function through a computer controlled guidance system programmed in advance to execute destructive energy firing orders

only upon confirmation of designated enemy targets.

The development of high-energy lasers, particle-beam weapons or other directed energy instruments possessing controllable energy levels or possibly variable beam widths would also ensure relatively accurate delivery of the destructive force to the target. This unique mode for the delivery of the destructive force to the target may make the directed-energy weapon superior to many alternative systems. While modern land, sea and air delivery systems utilize advanced guidance concepts including sophisticated ballistics computers and the low-intensity laser or microwave radar beam rider systems, probably none could compare more favorably with a fully developed directed-energy system for at least line-of-sight accuracy. With the directed-energy weapon, it would no longer be necessary to "lead the target" as required with existing systems. The zero-time-to-target characteristic of the directed-energy weapon ensures that the onset of target destruction commences simultaneously with the initiation of firing, whereas with other systems a time element necessarily ensues which could result in the target moving or noncombatants entering the preselected target area.

A second inquiry which aids in application of the fundamental principles is whether the use of the new weapon would necessarily result in excessive injury to protected persons or property resources. As noted in AFP 110-31.6-3(c):

The existing law of armed conflict does not prohibit the use of weapons whose destructive force cannot strictly be confined to the specific military objective. Weapons are not unlawful simply because their use may cause incidental casualties to civilians and destruction of civilian objects. Nevertheless, particular weapons or methods of warfare may be prohibited because of their indiscriminate effects.²⁷⁶

Virtually any weapon can be *used* in an unlawful manner, but such use does not necessarily make the weapon itself *per se* illegal. The category of weapon which

is prohibited *per se* under the collateral concept of indiscriminate weapons is that device which is incapable of being adequately controlled as a result of particular design or functional characteristics. Typical examples of devices violative of this concept are the World War II German V-1 and V-2 rockets which possessed guidance systems so primitive that these weapons could not be directed to specific targets with any certainty.²⁷⁷

The directed-energy weapons currently under research and development, when operational, will be relatively discriminating. However, the particular limitations of the HEL, unless corrected, could bring about ancillary injury to noncombatants located in the vicinity of the target. If a HEL weapon is used against a military target which is adjacent to an area populated by noncombatants, these protected persons could be subject to corneal or other eye damage and other forms of personal injury caused by indirect exposure to the laser source.²⁷⁸ Observations by scientific journals and high-energy laser authorities indicate possible adverse ancillary effects upon friendly combatants not within the direct field of the beam itself continues to be a matter of concern to weapons developers.²⁷⁹ Presumably if indirect laser energy is sufficient to threaten friendly armed forces in the vicinity of the battle, it continues to pose a threat to noncombatants also in the area.

Although there is no available information with regard to possible ancillary personal injury or property damage resulting from PBW's, it appears somewhat less likely since the directed beam of particles and not light energy acts as the destructive force. Unlike light energy which is subject to spreading and diffusion, the particle-beam can be directed from source to target with minimal dispersion. In any case, it appears that directed-energy weapons as a class may still be relatively discriminating as compared to other weapons of great coercive potential. Tests may very well show the ancillary injury and

destruction of protected resources is comparatively less with the typical use of a directed-energy weapon than might be expected by using a nuclear or high explosive conventional weapon. Even if research and developmental testing demonstrate that some one or more of the directed-energy devices have a substantial tendency for producing adverse effects to protected persons or property in the vicinity of the conflict, such determination would not rule out the use of the weapon against unmanned vehicles in near space or elsewhere.

A third juridical measure under the fundamental customary and conventional law criteria is whether the weapon's effects would be uncontrollable or unpredictable in space or time in a manner to cause disproportionate injury to noncombatants or damage to protected resources.²⁸⁰ This measure brings the collateral concept of proportionality to bear by asking whether the design or functional characteristics of the weapon are such as to typically bring about more ancillary personal injury or property damage than warranted by the military advantages gained from the weapon's use. A typical example might be a delayed action land or submarine mine which while perhaps efficient as a military instrument against combatants during the conflict, would cause at least equally deadly results subsequent to the reestablishment of peace. Unless these devices are automatically self-defusing within a reasonable period of time, the potential deprivation of human and material values resulting from use is disproportionate to the military advantage gained. They may be said to be uncontrollable in time.

The directed-energy weapon appears to present no problems with regard to controllability over time. It also will generally be controllable with respect to space, except with respect to possible ancillary damage to noncombatants or even nontargeted combatants in the vicinity of the HEL beam and its objective. Whether such ancillary personal injury would be considered disproportionate would be a function of the importance of the military objective and the number of

protected persons adversely affected.

A fourth inquiry which assists in the functional application of the criteria suggested by customary and general conventional law principles is whether the use of an innovative weapon would result in unnecessary suffering in relation to the military purpose served.²⁸¹ This measure is a direct test of Article 23(e) of the Annex to the Regulations for the Hague Convention IV and the proscriptions contributed to the customary international law by the St. Petersburg Declaration of 1868.²⁸² As again noted in AFP 110-31:

This prohibition against unnecessary suffering is a concrete expression of the general principles of proportionality and humanity. The rule reflects interests of combatants in avoiding needless suffering. Weapons are lawful, within the meaning of the prohibition against unnecessary suffering, so long as the foreseeable injury and suffering associated with wounds caused by such weapons are not disproportionate to the necessary military use of the weapon in terms of factors such as effectiveness against particular targets and available alternative weapons.²⁸³

It is not the degree of suffering which is critical in this instance, but rather whether the suffering produced is disproportionate or needless to military objectives sought through an application of the weapon. An example of a weapon prohibited *per se* as causing unnecessary suffering would be the dum dum bullet.²⁸⁴ However, as observed previously, some types of otherwise proscribed weaponry might be considered lawful against a target which does not lend itself to efficient attack from alternative devices. Military necessity may function to authorize an otherwise proscribed weapon for use against a fortified or heavily defended target.

The directed-energy weapon, particularly the HEL, may indeed be subject to limitations pursuant to customary and conventional law proscriptions against unnecessary suffering or superfluous injury. In addition to probably not being cost-effective, the use of the HEL as an antipersonnel device would no doubt create unnecessary suffering.²⁸⁵ The International Committee of the Red Cross

in its 1973 Report on the Work of Experts observes that in addition to possible temporary or even permanent damage to the cornea, certain other personal injury may result from the high-energy laser:

As regards the action of lasers on the human body, laser light may give rise to several damaging effects, including heat, pressure, possible shock waves (both accoustical and ultrasonic) and protein generation in the blood plasma. At the present level of understanding, the most important effects on human tissue seem to be heat and pressure. Tissue ionization, chemical transformations and disturbances of the blood circulation may also occur at the impact site.²⁸⁶

The combination of these various physiological effects upon the human body is no doubt such as to rule the HEL out as an antipersonnel weapon. However, as an instrument for use against ships, planes, military land-based facilities or vehicles and spacecraft, the high-energy laser would probably be construed as lawful. In an antimateriel mission it would compare favorably with most other weapons as a particularly efficient means of destruction. Incidental personal injury in connection with destruction of aircraft, spacecraft, ships, tanks, fortifications or other military objectives would probably not violate the rule against unnecessary suffering or superfluous injury.

One factor which must be taken into consideration however, is the unusual characteristic of the high-energy laser to destroy some target materials more rapidly than others. As noted in connection with the discussion of the HEL characteristics and capabilities, the laser's force may cause initial²⁸⁷ destruction to components in a target which ablate easily. This characteristic may cause injury or death to personnel, particularly in the case of an aircraft or spacecraft, as a result of rapid depressurization or imploding debris and not through thermal effect. Since such injury or death may actually be less painful than that brought on by thermal effect, the use of a HEL weapon against certain types of manned targets may be no less humane than employing existing weaponry.

2. Claims Based on Progressive Principles

In the view of the Stockholm International Peace Research Institute, a principle is evolving in the customary law if not through the conventional regimes which addresses the threat a particular weapons system poses to the very survival of mankind.²⁸⁸ The Stockholm Institute observes that the principle should be applicable as a criterion in judging weapons which can effect a massive deprivation of values not only among the combatants, but with respect to noncombatants and future generations as well.

The characteristics and capabilities of the high-energy laser and particle-beam weapon do not appear likely to violate the principle of survival. These directed-energy weapons are sufficiently discriminating so as to be able to limit the application of their coercive force against the designated target.²⁸⁹ Noncombatant states and their inhabitants are not apt to be affected by high-energy laser or particle-beam weapon attack, nor are future generations in combatant states going to experience adverse reactions to the use of these weapons. In fact, the argument could be made that these weapons may be indirectly supportive of the principle of the survival of mankind.

As will be discussed at a later point in the study, strategic planners and international decision-makers may wish to seriously consider advanced directed-energy weaponry as a means of backing away from those devices presently dominating superpower and major power arsenals which unquestionably do pose a threat to the world community in the present as well as in future generations. While the directed-energy weapon when developed could offer participants the capability of generating tremendous destructive force, such force would be more controllable than many nuclear, thermonuclear, chemical and biological weapons systems. To the extent the directed-energy weapon provides a more controllable, but equally destructive means of ensuring major

participant national security in the minimum world public order system, it may well be supportive of the principle of survival.

If a claim to the permissibility of directed-energy weapons can employ the principle of survival as an institutional basis, so also can at least one counterclaim. Directed-energy weaponry introduced for the limited strategic purpose of interdicting reconnaissance vehicles such as the U.S. Air Force's "Big Bird" satellites or high altitude, supersonic aircraft like the SR-71, may well threaten the delicate balance of strategic power thereby interfering with the strategy of deterrence. Additionally, the use of directed-energy weaponry in an anti-ballistic missile system may well decrease the credibility of the existing mutual deterrent between the superpowers and concomitantly encourage the possibility of a preemptive attack. If one participant believes it could launch a preemptive first strike knocking out the greater portion of its opponent's retaliatory deterrence force and then simply selectively incinerate those remaining retaliatory strike forces which escaped preemptive destruction, the theory of deterrence becomes inoperative. If the directed-energy weapon is deployed as an ABM system or as a means of destroying early warning or reconnaissance capability, it would decrease the credibility of the deterrent.

The ABM Treaty, through its doctrine of noninterference with national means of verification, implicitly recognizes the principle of survival.²⁹⁰ Moreover, the concept of the ABM Treaty itself is predicated on the assumption that any measure which decreases the credibility of the deterrent, may pose a threat to the participants' interests. Perhaps the preambular language of the Treaty-"Proceeding from the premise that nuclear war would have devastating consequences on all mankind"- is the clearest manifestation of the principle of survival at work in this particular institution.²⁹¹

If directed-energy weaponry is deployed or used so as to reduce the impact of the existing strategy of deterrence, it is likely to contravene the evolving principle of survival. To this extent it may be said that survival as a principle is a basis for claims seeking to limit deployment and use of the directed-energy weapon. Such specific limitations would apply to the use of the directed-energy weapon against reconnaissance systems as well as against the strategic deterrence forces themselves including such delivery systems as the ICBM, strategic bombers and even the innovative cruise missile. If the directed-energy device serves to threaten any of these systems, a claimant could assert it only acts to increase the possibility of massive coercion between the superpowers by increasing the possibility of one participant or the other initiating a preemptive strike.

This claim is persuasive and would seem to indicate if directed-energy weapons are to be lawful, they must not contravene the strategy of deterrence. However, having said this, it is equally important to bear in mind that the directed-energy weapon may actually be used not to reduce the impact of the deterrence strategy, but to enhance or strengthen it. If the directed-energy weapon is developed to the extent where it provides a more controllable and discriminating substitute for existing weapons of mass destruction used in support of the major and superpower participant deterrence strategies, it may actually prove a positive development in the effort to advance toward an improved minimum world public order system. Such substitution would of course assume that directed-energy weapons can be developed which have sufficient destructive potential to be a credible substitute for nuclear or thermonuclear weapons which are used by reason of the fact they do indeed create a "balance of terror." Claims to permissibility of directed-energy weapons based upon the principle of survival could also be predicated on the deployment or use of these devices in

support of other institutional mechanisms designed to enhance international peace and security. In other words, it should not be assumed that deterrence is the only means by which massive coercion can be prevented. One day it may be possible to employ directed-energy weaponry as a means of arming an international enforcement agency for the purpose maintaining the peace.

At least some of these various claims and counterclaims appear to have persuasive value. Based on the principle of survival, the stronger claims are those which would best enhance international peace and security, while decreasing the possibility of massive deprivation of values both in current and future generations. Specifically, it would seem in both the exclusive and inclusive interests of the participants to avoid the use of directed-energy weaponry in a way which would detract from the credibility of the existing deterrent. Such a claim would have to be specifically implemented through concrete bilateral or multilateral agreements which might address various limitations on the use of these devices against strategic forces or support facilities. Alternatively, claims which might provide for the use of the directed-energy weaponry as a means of providing a safer substitute for existing dangerous weaponry in the deterrence forces would seem to have great merit.

A second progressive principle which appears particularly relevant to the directed-energy weapon is that which seeks to preserve the environment.²⁹² As evidence in support of the evolution of this progressive principle, SIPRI has recalled a number of of General Assembly resolutions addressing the import of the natural environment and of avoiding coercive action which might endanger it. General Assembly Resolution 3264 (XXIX) of December 9, 1974 proclaimed that "(I)t is necessary to adopt, through the conclusion of an appropriate international convention, effective measures to prohibit action to influence the environment and climate for military and other hostile purposes, which are incompatible with

the maintenance of international security, human well-being and health."²⁹³

A concrete application of this principle requires inquiry into the short and long term ecological effects of the use of the directed-energy weapon. It is important to examine both the direct effects upon the ecology, such as any immediate destruction of living or nonliving resources, as well as indirect effects, such as alteration of weather patterns through possible effects on the earth's ozone layer. Insufficient information is publicly available to adequately answer these queries. However, based on the limited data available, it appears both the high-energy laser and the particle-beam weapon present no major direct or indirect ecological threat. Certainly target areas in the terrestrial theaters subjected to the destructive forces of these weapons would experience thermal, shock and a variety of other related forms of damage. However, based on presently disclosed data, it appears the use of these devices would not tend to cause pervasive ecological modification or destruction of environmental values outside the immediate target area. Moreover, it should be noted that since most authorities are now projecting at least the first operational deployment of the HEL will come in near space and that problems of beam attenuation may limit its use in terrestrial zones, there may be little or no potential for an adverse impact upon the environment in the immediate future in any case.²⁹⁴

From the perspective of ecological and environmental preservation, the directed-energy weapon may again offer certain comparative advantages over alternative systems in participant arsenals. Discussing this principle, the SIPRI observes:

The environment is already threatened by certain existing modern weapons, in the first place by nuclear weapons, but also by chemical or bacteriological weapons calculated to destroy crops or to defoliate trees (herbicides). Certain of these weapons aim at the destruction of the environment, either as a means of terrorizing the civilian population, or as a means of denying the foliage that may conceal military action.²⁹⁵

It would be inaccurate to suggest that directed-energy weapons can necessarily accomplish all the various strategic and tactical military missions with effectiveness equal to or better than alternative weapons systems. However, in those instances where the directed-energy weapon's characteristics and capabilities are competitive with alternative devices, whether conventional or weapons of mass destruction, the principle of environment should be invoked in a determination of comparative efficiency. Whichever weapon tends to exhibit the least adverse ecological impact, all other claims being equal, should be considered the preferred device for use in coercive activity.

Claims to directed-energy weapon permissibility based on a comparative analysis with alternative systems are generally consistent with participant exclusive and inclusive interests. In armed conflict, particularly in cases of massive vice limited coercion, a combatant's exclusive interests tend to be little enhanced by the use of inefficient weapons or devices which destroy or endanger environmental resources. Measures taken against an enemy's natural resources may in isolated cases yield benefit. If a HEL was used to ignite forest fires or explode petroleum reserves, some immediate advantage might be gained. However, such obvious misuse of the weapon could prove counterproductive or even cost-ineffective. It could lead to retaliatory steps which would certainly be inconsistent with an attacker's exclusive interests. Generally, the HEL and PBW can be used so as to avoid such results.

The use of directed-energy devices against environmental values would also be inconsistent with inclusive interests. It would tend to expand the conflict causing increased deprivation of values. In addition, since there is increasing recognition that the earth's ecology is intricately interrelated, it would be shortsighted of any participant to employ the use of any weapon purely to perpetrate environmental damage. In the long run, such action might

could prove counterproductive to the attacking participant's own national interests which may be indirectly dependent upon the ecological stability and well-being of its opponent's resources.

Sanctions against the use of directed-energy weaponry for environmental damage could be based on enforcement mechanisms contained in a specific agreement limiting use of such devices. Alternatively, certain positive sanctions may even now exist in the form of mutual reciprocity between and among participant states. As will be further discussed with regard to prospective conventional developments, it now appears the international law of armed conflict may be specifically adopting this principle. If so, additional sanctioning mechanisms including holding participant officials personally responsible as international war criminals in the event of conventional violations may tend to constrain state military actions and promote compliance with rules seeking to preserve the environment. Finally, although directed-energy weapons are probably an inefficient means of causing broad ecological damage, should they be applied for this purpose, the controls of the Environmental Modification Treaty^{29c} may eventually apply to render such use illegal.

A third progressive principle which could influence claims to lawfulness of directed-energy weapons is the concept of threshold. As noted previously, the threshold concept assumes that the deployment or use of certain weapons, particularly those within an explicit class of weapons of mass destruction, may result in a general escalation of the conflict in which virtually all weapons of the same classification would be unleashed. The threshold principle as formulated by SIPRI would be invoked so as to proscribe the use of even those weapons within the classification which might be applied in a lawful manner, if to do so would open the door to far more destructive weapons of the same type.

From the perspective of the SIPRI, the threshold principle would have particular importance with regard to nuclear, biological and chemical weaponry. However, as noted, the basic assumptions upon which the principle is based are open to challenge.

Without addressing the validity of the principle's assumptions in detail, it appears the concept of threshold has little persuasive value as a means of prohibiting or limiting the directed-energy weapon. It may be true that the use of a relatively low power directed-energy weapon, for example a chemical laser mounted aboard a killer-satellite, could encourage the use of larger, more powerful devices. However, even if this is the case, the comparative value of the directed-energy weapon as a relatively more discriminating and controllable device cannot be dismissed. If even the larger, more powerful instruments in the directed-energy class exhibit characteristics of greater discrimination and control when compared with alternative weapons systems, the application of the threshold principle in the case of this new category of weaponry may be ill-advised. To apply the principle so as to strictly prohibit the use of the HEL or PBW in every case on the theory that to do so would necessarily escalate the scope of the coercion, may very well prove inconsistent with the maintenance of the minimum public order. Moreover, it may be counterproductive to efforts to seek the optimum world public order system in the long run.

Even if the threshold principle is considered valid with respect to the PBW or the HEL, critical distinctions as to use may be relatively easily drawn and observed if it is in the interests of participants to do so. For example, based on the present state of the art, the HEL appears particularly efficient in space but poses a significant threat of causing unnecessary suffering in terrestrial theaters, particularly if used in an antipersonnel mode. If this continues to be the case despite research and development efforts to eliminate undesirable effects, it should be in participants' interests to

prohibit the use of the HEL in the terrestrial theaters, at least as an anti-personnel weapon. At the same time, it would be relatively easy to authorize the use of the HEL in near space. In other words, a threshold could be keyed not to the mere use of the weapon, but rather to operational theaters where it would be prohibited. In such a regime, many of the same sanctions which have applied in the cases of the other principles could no doubt serve to support weapons controls.

D. Controls Applicable to Analogous Weaponry: Incendiary Devices

1. Scope and Limitations of the Analogy

A second institutional basis in the law of armed conflict which may serve as a source for claims bearing on the control of directed-energy weapons exists through an evaluation of analogous weapons. Evaluation by analogy can provide an important perspective on the practice of participant states with respect to rendering weapons or their use in particular circumstances either prohibited or limited. Claims of unnecessary suffering and superfluous injury based on both the customary law and conventional regimes must be applied in the context of the practice of states. Specifically, claims regarding target selection or legitimate objects of attack are best evaluated in terms of practical experience. If analogous weapons and coercive circumstances can be found which are applicable to particular innovative weapons systems, they tend to greatly improve the accuracy of the juridical evaluation.

At the same time, the limitations and potential pitfalls of evaluating through analogy should be recognized. It should be acknowledged that while some facets of a new weapon may be analogous to an existing system, there may be

vast differences in characteristics and limitations. Professors McDougal and Feliciano in commenting on the analogies sometimes invoked between poison or poison gas and nuclear weapons, address another basic limitation of analyzing through comparison:

In particular, it may be noted that the argument about the supposed nonpermissible character of nuclear weapons is derived principally by analogy from earlier prescriptions about poisonous gas, poisoned arms and other weapons causing disproportionate suffering. *Analogies are important, however, only so far as the policies they suggest are relevant;* and analogies suggest only the requirements, again, of compromise between military necessity and humanitarianism. (emphasis added)²⁹⁷

The point is clearly made that in examining claims to permissibility or impermissibility, it is necessary to evaluate pertinent participant policies which dictate the possession and ultimate use of the weapons themselves. McDougal and Feliciano suggest that despite the fact nuclear weapons share certain features in common with poison gas and poisoned arms, the fact that the latter category has been prohibited is not determinative of the status of the former. Military necessity, the influences of modern warfare and a consideration of certain aspects of humanity continue to be the basic rationale for weapons control. In evaluating by means of analogy it then becomes important to examine the operation of these basic factors upon participant policies which may seek to control the existing, comparable weapons system.

Since the physical principle upon which directed-energy weapons operate is unique to modern warfare, it is not possible to draw a direct analogy to any existing weapon. Instead, any evaluation through analogy to existing weapons must look to particular characteristics, limitations, modes of use or effects which both systems may have in common. To the extent such factors may have had a bearing on the juridical determination of lawfulness of the existing system, they may be relevant to a legal appraisal of the innovative weapon.

A principle consideration implicit in both customary law and conventional principles often seems to be a weapon's effect upon particular targets. Depending upon the nature and scope of such effects, claims may arise as to the prohibition of the weapon *per se* or its limitation as to use against particularly vulnerable targets which for humanitarian or other reasons merit special protection. The expected physical effects of the HEL and perhaps the somewhat less well understood PBW upon targets will entail thermal destruction, shock waves, and certain causally related destruction or injury. Although no known weapon presently existing in participant arsenals would necessarily bring on all these same effects, at least in the same degree or manner, at least one system should be considered as partially analogous.

A variety of Twentieth Century incendiary weapons may produce at least some of the same destructive thermal effects. These weapons have been applied in an extensive number of tactical military roles in several wars and have generally caused substantial devastation and loss of life.²⁹⁸ One of the more widely used incendiary weapons has been the napalm firebomb which was originally used by battlefield commanders as an antimateriel weapon, principally against mobile armor and heavily protected emplacements. Napalm has proved a relatively efficient means of penetrating such targets. The firebomb has also been used as an antipersonnel weapon and in this connection exhibits two "advantages." In addition to being capable of quickly blanketing an extensive area with destructive force, it also evokes a demonstrable negative psychological effect in the personnel against whom it is used.²⁹⁹ Incendiaries, particularly the firebombs, have also been employed in a strategic role against large population centers as demonstrated in the allied raids against Germany and Japan in World War II.³⁰⁰

Incendiary weapons produce particular physiological effects in consequence of the thermal energy directed on target. Persons receiving burns to more than

60% of their body are apt to die unless given quick and highly specialized treatment in a modern burn hospital.³⁰¹ Burns which cover more than 5% of the body surface tend to demand more medical resources than other types of disabling injury. Burn injuries are considered relatively more painful than many other combat wounds sustained by personnel and often tend to require prolonged treatment. Burn injuries are also inclined to produce permanent scars, contractures and other types of deformity which may bring about lasting physical, psychological and emotional repercussions. Many other specific and generally extremely adverse reactions are typically experienced by those unfortunate enough to be victims of incendiary weapons.³⁰² Since directed-energy weapons, particularly the high-energy laser, cause thermal effects in their targets, there appears a similarity between the incendiary and this innovative category of weaponry at least with respect to form of destructive or injurious effects they bring about.

2. Claims to Weapons Prohibition *Per Se*

Having in mind both the strengths and the weaknesses of the analogy, the first question is whether incendiaries are subject to prohibition *per se*. The particularly heinous effects that incendiary devices may produce with respect to human and other living resources has undoubtedly been the major factor in the historical concern of the international community for these weapons.³⁰³ However, despite this concern, there exists no pervasive international rule against participant development, production, stockpiling, or deployment of incendiary weapons.

As perhaps some indication of the attitudes of many of the Western participant states toward incendiary weapons, the Commission of Jurists which drafted the Hague Air Warfare Rules of 1923 stipulated in Article 18

that "the use of tracer, *incendiary* or explosive projectiles by or against aircraft is *not prohibited*, and that this provision applied equally to all States whether or not they were parties to the Declaration of St. Petersburg of 1868." (emphasis added)³⁰⁴ Although the Draft Rules were never implemented, they are often considered as a consensus statement of participant state views as of 1923 with respect to certain limitations on aerial warfare and the use of weaponry. In effect, the Draft Rules suggested that incendiary devices could be used at least in the case of aerial warfare. The Geneva Disarmament Conference of 1932-33 also took up the issue of the lawfulness of the incendiary. The Draft Disarmament Convention instrument presented at the end of the conference without opposition was designed to explicitly prohibit both the use of projectiles intended to cause fire and appliances designed to attack persons by fire.³⁰⁵ The provisions of this convention probably evidence the concern for the adverse affects of the incendiary and participant desires to emphasize humanity. However, the convention was not adopted and it appears ultimately, military necessity and efficiency of the weapons system prevailed.

The strongest evidence of the general permissibility of incendiary weapons stems from an examination of the recent practice of participant states in combat. Incendiary weapons were used extensively in World War II. They were also applied by armed forces functioning under the authority of the United Nations in the Korean conflict.³⁰⁶ More recently, the U.S. employed incendiary weapons including napalm in Vietnam. In what may be a unilateral policy statement with respect to the lawfulness of incendiary weapons, the U.S. Army's publication FM 27-10, *The Law of Land Warfare* provides *inter alia*, "*The use of weapons which employ fire, such as tracer ammunition, flamethrowers, napalm and other incendiary agents against targets requiring their use is not violative of international law.*" (emphasis added)³⁰⁷ It seems clear that at least United States policy authorizes the use of the incendiary against

certain kinds of targets.

The SIPRI in its analysis of "dubious weapons" while taking the view that there is a substantial body of participant support for a prohibition *per se* of incendiaries, nevertheless implicitly acknowledges that their existence has not as yet been outlawed. In commenting on ICRC efforts to develop a prohibition, the SIPRI report states:

On the basis of the results of an expert conference on napalm and other incendiary weapons, the ICRC concluded that for the time being, and without prejudice to any total prohibition formulated subsequently, the only practicable course open to the ICRC was to concentrate on restrictions on the use of incendiary weapons.³⁰⁸

While deploring the current state of the international law with respect to incendiaries, the SIPRI report acknowledges the current permissibility of these devices in these words:

They (incendiaries) *should be* expressly forbidden. Such an express prohibition is needed in view of the former praxis and the existing differences of opinion, apparent from national military manuals and scholarly publications. In view of the repulsive character of the weapon, the prohibition of incendiary weapons *should be* general, with the possible exception of some forms of anti-materiel use. (emphasis added)³⁰⁹

Moreover, it may be noted that even the recently drafted Protocol I to the Geneva Conventions of 1949 fails to provide any explicit proscription against incendiary devices.³¹⁰

The failure of the international community to reach a consensus in support of the prohibition *per se* of incendiary weapons does not necessarily guarantee the permissibility of directed-energy weapons. However, it does suggest that so long as directed-energy weapons are considered efficient means of destruction for at least some purposes, the Royse thesis will discourage pervasive participant acceptance of claims to general impermissibility.

Incendiary devices have thus far been retained in participant arsenals because they are able to accomplish some missions more effectively than alternative weapons systems. There is a *military necessity* which seems to authorize their use. Assuming the this could also become the case with either the high-energy laser or particle-beam weapon, the Royse thesis would tend to support claims as to permissibility of these innovative systems. At the moment, it appears there is a good chance that the HEL or PBW may be particularly effective in air or near space defense systems and to this extent perhaps considered essential to participant arsenals. In short, despite the horrendous physiological effects caused by the HEL, if not the PBW, so long as these devices are more militarily efficient than alternative systems, it appears unlikely they will be prohibited *per se*.

3. Claims to Restricted Use in a Regime of Weapons Control

A point which is sometimes lost in evaluation of weapons control is that even if a prohibition exists against a weapon *per se*, certain sanctioning mechanisms typically function through the international law of armed conflict to ensure the credibility of the proscription itself. In addressing this point with respect to nuclear weapons, Professor Mallison observes:

Even if it is assumed that nuclear weapons are unlawful, it seems clear that they may be lawfully used as legitimate reprisals in retaliation to the unlawful use of such weapons. There may also be other grim situations in which their use should be upheld juridically under the doctrine concerning legitimate reprisals.³¹¹

Applied to incendiary weapons or directed-energy devices, Professor Mallison's observations with respect to nuclear weaponry would suggest that even if a prohibition *per se* existed or would be developed, it would not necessarily function in all cases to bar the application of such instruments of coercion.

A generally accepted interpretation of the concept of reprisal has been provided by a United States military tribunal:

Reprisals in war are the commission of acts which, although illegal in themselves, may under the specific circumstances of the given case, become justified because the guilty adversary has himself behaved illegally, and the action is taken in the last resort, in order to prevent the adversary from behaving illegally in the future.³¹²

It should be understood that the doctrine of reprisal does not constitute a means to redress violations of general international law, since as previously observed, the minimum world public order system established through the U.N. Charter proscribes the use of force except under certain limited and controlled circumstances. However, if an enemy employs a weapon which has been prohibited *per se* against another state, the attacked participant is authorized to resort to the use of coercive instruments not otherwise permissible in order to compel the enemy to cease its unlawful actions or to discourage that enemy from again committing such violation.

Substantial limitations have been placed upon reprisals by the international law of armed conflict. The Geneva Conventions of 1949 and the recently completed Protocols greatly expand the scope of protection against reprisals.³¹³ Moreover, several resolutions of the U.N. Security Council have condemned "reprisals as incompatible with the purpose and principles of the U.N."³¹⁴ Nevertheless, the customary international law of armed conflict and the practice of states still appear to authorize the application of reprisals as sanctioning mechanisms albeit under restricted circumstances.

Hence, should the movement to outlaw incendiary weapons succeed or should a pervasive proscription be developed against directed-energy weapons, it is likely that limited use of these devices would be authorized in any case through a strict application of the doctrine of reprisal. Moreover, as already

indicated, should the directed-energy weapon be found an efficient supplement to, or substitution for, existing coercive instruments employed in strategic deterrence forces, it may be authorized on the grounds of being a lawful weapon of mass retaliation. While retaliation as a doctrine is far broader and less explicit than reprisal, as long as the strategy of deterrence influences the national policy of the principal powers, massive retaliation is likely to be retained as the prophylactic mechanism for discouraging a preemptive first strike. It is virtually certain that should such mass coercion ever occur, participants would largely ignore international constraints against particular weapons if such devices were considered efficient means of conducting strikes or counterstrikes.

In brief, although there are no pervasive prohibitions against incendiary devices, even if there were, claims would still exist to their restricted use in sanctioning processes. The same thing would apply to any future prohibition of the directed-energy weapon. Moreover, should these weapons be found effective in support of strategic deterrence forces, although their use might otherwise be outlawed, participants would probably not hesitate to employ them in massive retaliatory counterstrikes. While such use might strictly constitute a violation of the international law or some specific prohibition contained in strategic arms control law, this important qualification on the implementation of any institution to prohibition *per se* should be acknowledged.

4. Claims to Limitation on Use and Target Selection

By far the greatest number and perhaps most persuasive claims vis-à-vis incendiary weapons are based on the interrelated concepts of method of use and lawful objects of attack. Since the practice of states generally confirms the

validity of the Royse thesis, it might be expected that claims to such limitations upon use are closely correlated with relative efficiency of a given device when placed in a competitive field of weapons. In other words, limitation of use of the incendiary and possibly the directed-energy weapon would not normally be expected where the instrument is considered comparatively efficient as a means of coercion.

The criteria which seems to have been again invoked with respect to limiting the use of incendiary weapons, however, are the Hague principles of avoidance of both unnecessary suffering and superfluous injury. In addition, the customary law concept of minimization of indiscriminate effects also constitutes a criterion frequently applied in evaluating incendiary devices. While acknowledging the general permissibility of incendiary weapons, Article 36 of the U.S. Army's FM 27-10 states *inter alia*: "They (incendiary weapons) should not, however, be employed in such a way as to cause unnecessary suffering to individuals." ³¹⁵ This seems to confirm at least one major participant's view as to the importance of these criteria with regard to the incendiary weapon's legal use in battle.

A generally consistent but more concrete interpretation of incendiary weapons and their proper use is offered in AFP 110-31, with particular reference to the use of these instruments in air operations. ³¹⁶ In echoing the Army policy statement's concern for unnecessary suffering and the potential adverse effects of incendiaries, paragraph 6-6(c) enunciates *inter alia*:

Controversy over incendiary weapons has evolved over the years partly as the result of concern about the medical difficulties in treating burn injuries, as well as arbitrary attempts to analogize incendiary weapons to prohibited means of chemical warfare. The potential of fire to spread beyond the immediate target area has also raised concerns about uncontrollable or indiscriminate effects affecting the civilian population or civilian objects. Accordingly, any applicable rules of engagement relating to incendiary weapons must be followed

closely to avoid controversy. The manner in which incendiary weapons are employed is also regulated by the other principles and rules regulating armed force . . . In particular, the potential capacity of fire to spread must be considered in relation to the rules protecting civilians and civilian objects For example, incendiary weapons should be avoided in urban areas, to the extent that other weapons are available and as effective. Additionally, incendiary weapons must not be used so as to cause unnecessary suffering.¹³⁷

This U.S. Air Force interpretation clearly acknowledges the potential ancillary effects caused by the incendiary's thermal destruction. The principal concern expressed is that such ancillary destruction could spread from combat zones to protected noncombatant areas. It is clear that the military commander considering the use of the incendiary is under an obligation to carefully weigh its potential for producing ancillary or indiscriminate damage through its inherently uncontrollable effects. The military commander is enjoined from the use of an incendiary when its application would produce unnecessary suffering. Moreover, he is directed to consider alternative weapons when the risk of ancillary damage or injury is deemed too great.

Under Protocol I to the Geneva Conventions, the general protection for noncombatants and their resources has been greatly strengthened. The basic rule contained in Article 48 for the protection of civilians against hostilities provides:

In order to ensure respect for and protection of the civilian population and civilian objects, the Parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives.³¹⁸

Although it may be sometime before Protocol I is adopted by all major participants, the Article 48 rule provides a strong indication of the general consensus in the international law for the strict protection of noncombatants and their resources. No qualifications or limitations are apparent in this

article or related provisions in Protocol I which would seem to authorize the use of even the most discriminating and humane of weapons systems against protected persons and property. Through this proviso, a significant control may be evolving and may soon be adopted through acceptance of this conventional regime.

Limitations on the use of the directed-energy weapon against noncombatants and their resources are based less on analogy to the incendiary than on the customary and conventional regime. However, analysis by analogy with the incendiary does suggest possible controls affecting the application of directed-energy weapons against combatant objectives. Incendiary weapons are often used with substantial efficiency against materiel targets and combatants in the immediate vicinity of such targets. Their application against fortifications, pill boxes and armored vehicles is generally accepted. However, they are also effective in tactical air support aiding ground troops engaged in close combat with enemy forces. In this capacity, there can be little doubt but that the incendiary, despite its adverse physiological effects, is employed in an antipersonnel mode.

It is this latter tactical use of the incendiary weapon which has caused the greatest concern to humanitarians concerned with reform of the international law of armed conflict. In what is undoubtedly an overstatement of the actual state of the customary law, the SIPRI observes:

It is self-evident that anti-personnel incendiary weapons violate many principles of the laws of armed conflict. They may cause unnecessary suffering and are indiscriminate in their effects. They are inhumane and repulsive weapons contrary to 'the laws of humanity and the demands of the public conscience.'

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General participant perspectives of this type have lead to convening a preparatory meeting to organize a conference of governments for the purpose of developing prohibitions or restrictions applicable to certain conventional

weapons. U.N. General Assembly Resolution 152 (XXXII) dated December 1977 specifically endorses a recommendation of the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law to convene a preparatory conference in 1978 for the purpose of organizing a full conference in 1979.³²⁰ Both the Diplomatic Conference and the General Assembly have recommended that the conference give particular attention to developing more concrete controls applicable to incendiary weapons.

In view of the adverse physiological effects caused by incendiaries, it appears the strongest consensus for limitation will apply to their use in an antipersonnel mode. If this or even a broader limitation should result from the 1979 conference of governments, it could have a substantial analogous impact on the treatment of other weapons which perpetrate thermal damage or injury. It might be difficult to distinguish the use of an incendiary from other types of thermal effect weapons including directed-energy devices when the effects on particular targets are similar in nature.

Authority Philip J. Klass observes that present indications are that the U.S. Defense Department has no plans to use the HEL in an antipersonnel mode. In connection with his analysis of HEL characteristics, he notes:

The Defense Department has no plans to try to use high-energy lasers as anti-personnel weapons according to one Pentagon official. This view stems from practical realities rather than humanitarian considerations.

'The high energy laser radiation weapon is simply too expensive and complex to be considered for use against personnel and effective countermeasures are too easy,' this official believes.

'Any effort to employ radiation weapons against personnel will bring back the use of the metal shield or a less expensive coated Mylar version to reflect the laser beam back to its source,' he added.

Because a radiation weapon is inherently a line-of-sight device, 'a foot soldier need only hide behind a rock and lob mortar shell at the expensive high-energy laser weapon. Even if the shell fails to hit the radiation weapon, it will spew dust on its optical system, destroying its effectiveness,' the official added.³²¹

Klass presents the possibility of physical limitations against the use of the high-energy laser as an antipersonnel weapon. However, there is a distinct possibility that the HEL attack could be staged from areas superjacent to the target. Presumably some of these supposed limitations would no longer apply if the HEL was mounted aboard either an aircraft or orbital space vehicle. Moreover, the high-energy laser might even be used to create a massive firestorm in the combat area. This sort of secondary effect of the HEL could prove highly destructive and perhaps militarily more cost-effective than Mr. Klass or his Pentagon source would care to admit.

Admittedly, the analogy between the incendiary and the directed-energy weapon has limitations. The analogy appears to be most persuasive with respect to the high-energy laser. Too little is known as of this time with regard to the actual effects of the particle-beam weapon on its target. For this reason, it is difficult to analogize the incendiary and PBW on the basis of target effects. However, should it be confirmed the PBW does create essentially thermal effects upon its targets, the analogy may apply equally well to this particular directed-energy weapon.

In applying the analogy and considering the controls imposed on incendiary devices, it is well to remember that the directed-energy weapon is apt to be considerably more precise and controllable. By controlling the size of the beam, the amount of energy, or the firing time, the combatant employing the directed-energy weapon may successfully avoid many of the adverse ancillary effects characteristic of the incendiary device. Accordingly, even if more pervasive controls are applied to the incendiary, the directed-energy weapons may be treated somewhat differently. What does seem clear in the final analysis, is that directed-energy weaponry, like the incendiary devices currently in participant arsenals, will probably not be authorized for antipersonnel use.

E. Evolving Conventional Law Controls

The juridical triad used in this evaluation of directed-energy weaponry is completed with a consideration of prospective developments in the law of armed conflict. The foregoing analysis has suggested that a limited number of selected controls may already exist both in the comprehensive international law applicable to the earth-space arena and the law of armed conflict including, in particular, constraints derived from custom, general convention and possible analogy. While bases may already exist in the international law which could support claims to control of directed-energy weapons, they are less than optimal from at least two standpoints. First, these various institutional bases were developed for purposes other than controlling highly innovative weaponry. No matter how apparently relevant the existing body of law vis-à-vis claims to weapons control, it can still be argued that it was never developed with an eye toward regulating weapons fundamentally unique to modern warfare. Secondly, existing bases for the control of directed-energy weapons are at best a patchwork of untested limitations and partial prohibitions. These bases do not provide a coordinated or particularly well-balanced regime of controls. Nor do they fully exploit certain advantages offered by the directed-energy weapon as a means of improving the minimum world public order system.

It is therefore important to consider certain key developments in the international law which seek to correct some of the shortcomings in the existing control regime. These developments, most in their infant stages, do not as yet constitute either a customary or conventional base for weapons control. However, they do indicate some important trends in the international law vis-à-vis innovative weapons control. Despite the import of the existing law, it is

likely that the most significant controls which will be applied to the directed-energy weapons will be those developed with an eye toward the unique characteristics of the weapons themselves.

1. Contemporary Criteria for Weapons Control: Protocol I

As a result of demonstrated need for a modification of the international law of armed conflict, the International Committee of the Red Cross (ICRC) held a Conference of Government Experts in 1971, 1972 and 1973 to draft two supplementary protocols to the four Geneva Conventions of 1949.³²² The principal issues of concern to the ICRC and most of the participants included improved enforcement of the 1949 Conventions, problems presented by "wars of national liberation," a need to clarify ambiguities in the law of armed conflict and improving upon protections afforded certain categories of persons.³²³ The first of the two supplementary protocols addresses international conflicts while the second applies to armed conflict within states themselves. The draft agreements referred to as Protocols I and II respectively, were taken up and considered by the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law applicable in Armed Conflicts in four sessions conducted between 1974 and June of 1977.

The Final Act of the Diplomatic Conference was issued on June 10, 1977 and officially opened for signature December 12, 1977. The Protocols have been signed by the United States and Soviet Union among other participants. As of early 1978, the executive branch of the U.S. Government had both Protocols under review in various administrative departments for purposes of formulating recommendations for possible action by the President.³²⁴ Depending upon Presidential decision, the Protocols may be subsequently referred to the

Congress for further review and possible ratification.

Neither Protocol I or II constitutes international law at least with respect to those states which have yet to ratify. Nevertheless, they are the result of an intensive multilateral effort over a period of years and in certain instances may represent a consensus of participant perspectives regarding the law of war. Although it is too early to evaluate the true impact of these two Protocols, pertinent provisions are nevertheless deserving of consideration as probable future bases for claims to the control of directed-energy weapons. The pertinent provisions of Protocol I, if adopted by most of the participant states including the principal military powers, will have a pronounced influence on claims to weapons control.

The preliminary question in considering Protocol I is its overall application. After recalling the duties of every state under the U.N. Charter to refrain from the threat or use of force and expressing the conviction that neither the Protocol nor the Geneva Conventions of 1949 authorize any act of aggression inconsistent with the U.N. Charter, the Preamble reaffirms that both the Geneva Conventions and the Protocol "must be fully applied in all circumstances to all persons who are protected by those instruments, without any adverse distinction based on the nature or origin of the armed conflict."³²⁵ This language does not appear to qualify the protections or standards of the Protocol in terms of any particular theater or scope of conflict. It further reaffirms that the law of armed conflict rejects the concept of "just war" as a possible defense to the strict application of international legal controls or protections.

Also indicative that the provisions of Protocol I are applicable on a comprehensive basis is the language of Article 1. Article 1 provides *inter alia*:

1. The High contracting Parties undertake to respect and to ensure respect for this Protocol in all circumstances.
2. In cases not covered by this Protocol or by other international agreements, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience.
3. This Protocol, which supplements the Geneva Convention of 12 August 1949 for the protection of war victims, shall apply in the situations referred to in Article 2 common to those Conventions.

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This language confirms the application of Protocol I to both massive and limited coercion. Moreover, it appears that Protocol I like other bases in the law of armed conflict is applicable in the expanded earth-space arena. Common Article 2 referenced in subparagraph 3, indicates that the 1949 Conventions will be implemented not only in times of peace but also in cases of declared war or other armed conflict regardless of whether combatant participants extend recognition to one another or not. Finally, subparagraph 2 appears to be an explicit reaffirmation by participants of their commitment to the fundamental principles of international law with particular reference to the principles based on custom, humanity and public conscience. This language would seem an effort to revitalize many of the fundamental principles and collateral concepts strained by combatant state violations in recent international conflicts.

Despite the broad scope of Protocol I, some major power participants have entered their signatures subject to important reservations excepting nuclear weapons from the purview of the convention. In stating its reservation to Protocol I, the United States declared "It is the understanding of the United States of America that the rules established by this protocol were not intended to have any effect on and do not regulate or prohibit the use of nuclear weapons."

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The United Kingdom and Northern Ireland in their joint declaration have announced an essentially identical reservation.³²⁸

Reservations such as these bear witness to the strength of continued major power commitment to the use of nuclear weapons for both deterrence and in support of NATO's policy of "flexible response" in which Alliance members assert the right to use tactical nuclear weapons to blunt any attack by the Warsaw Pact's massive and highly mobile armored forces in central Europe. It is interesting to note that none of the declarations recorded thus far to Protocol I appear to except other weapons of mass destruction including the innovative weapons systems which might share certain characteristics with weapons in the nuclear category. More specifically, the reservations do not appear to exempt the directed-energy weapon from whatever control provisions might exist within Protocol I.

Perhaps the most visible criteria for weapons control in Protocol I are contained in Article 35:

1. In any armed conflict, the right of the Parties to the conflict to choose methods or means of warfare is not unlimited.
2. It is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering.
3. It is prohibited to employ methods or means of warfare which are intended, or may be expected, to cause widespread, longterm and severe damage to the natural environment.³²⁹

The first two provisions are a reaffirmation of the general weapons control principles offered in the customary and conventional international law of armed conflict. Paragraph 1 virtually parallels the familiar language of Article 22 of the Annex to the Hague Regulations; "The right of belligerents to adopt means of injuring the enemy is not unlimited."³³⁰ Although Protocol Article 35(1), like the language in the Hague Annex, is broad and far too ambiguous to be reasonably enforceable, it reaffirms the international community's general perspective that states are subject to restraints in both the weapons they select

and how they choose to apply them in armed conflict.

Protocol Article 35(2) coincides with the two versions of Article 23(e) appearing in the Annexes to the Regulations of the Hague Conventions of 1899 and 1907.³³¹ This Protocol article serves to clarify the existing rule by reverting to the original 1899 English text language and supplementing it with alternative language found in the French text to the 1907 Annex, *propres a causer des maux superflus*, which is more accurately translated "of a nature to cause superfluous (or excessive) injury."³³² This provision endorses the customary law and conventional law doctrines prohibiting the use of a weapon which needlessly or unnecessarily aggravates human suffering. With regard to Article 35(2), a Department of Defense Working Group recounted both the U.S. and two other perspectives as to whether this provision offered significant change from the existing law:

(T)his text strongly supports the view that no substantive change in meaning to existing legal requirements is intended or effected. Indeed, the Federal Republic of Germany stated explicitly that they joined in the text on the understanding that paragraphs 1 and 2 reaffirmed customary law. India noted that it believed these rules applied to all weapons of whatever type.³³³

Article 35(2) serves to reaffirm both existing criteria and the interpretations of those criteria developed by the practice of states in evaluating the lawfulness of innovative weapons and their use. This reaffirmation acts to greatly strengthen the relevance and applicability of claims based upon the customary law norms, conventional rules and interpretation developed from practice in the era of modern warfare. *A fortiori*, as the first comprehensive restatement of the law of armed conflict since the advent of the expanded earth-space arena, it greatly enhances claims to weapons control based on existing institutions as they have been extended to govern the new space theaters.

The third provision in Article 35 is an effort to protect the environment against methods of warfare apt to cause extreme damage. The predominant issue

which will surround claims based on Article 35(3) is the meaning of "widespread, longterm and severe damage." The issue may be partially resolved by reading Protocol Article 55 *in pari materia* with Article 35(3). The mutually supportive provisions of Article 55 concerning protection of the natural environment state:

1. Care shall be taken in warfare to protect the natural environment against widespread, long-term and severe damage. This protection includes a prohibition of the use of methods or means of warfare which are intended or may be expected to cause such damage to the natural environment and thereby to prejudice the health or survival of the population.
2. Attacks against the natural environment by way of reprisals are prohibited.³³⁴

The language of Article 55(1) suggests that "widespread, longterm and severe damage" implies destruction which is apt to prejudice the health or survival of the population itself through the deprivation of important environmental resources.

A generally consistent interpretation of this language is offered in the 1975 report of the United States Delegation to the ICRC Diplomatic Conference:

According to the Report of Committee III 'long term' was considered by some to be measured in decades, with reference made to twenty to thirty years as a minimum and it appeared to be a widely shared assumption that battlefield damage incidental to conventional warfare would not normally be proscribed by the provision. The provision covers such damage as would be likely to prejudice the continued survival of the civilian population over a long term or risk long term health problems.³³⁵

This interpretation of Article 35(3) read *in pari materia* with Article 55 strongly implies that certain weapons of mass destruction, principally nuclear weapons, would be banned under this environmental control. Depending upon the intensity of fallout, nuclear weapons may deposit Cesium 137 and Carbon 14 in amounts which would create possible "long term major health problems." The

possibility of fallout from the use of nuclear weapons constituting a breach of Article 35(3) may have been an influential factor in participant state reservations exempting these devices from the Protocol's controls.³³⁶

Neither Article 35 nor 55 provides a basis for any comprehensive prohibition of directed-energy weaponry. Article 35 invokes the words "to employ" while Article 55 speaks to "use" in applying respective proscriptions. These terms clearly do not address research, development, testing, production, stockpiling or even deployment of weapons. A pervasive proscription covering such phases or aspects in the weapons evolution might more appropriately be a matter for the comprehensive international law, specifically within the field of strategic arms control. Nevertheless, Articles 35 and 55, once adopted, will provide a further basis for claims to limited use of directed-energy weapons.

There is probably also a persuasive claim based on Article 35(2) to prohibit the use of directed-energy weapons against relatively exposed or vulnerable personnel. Just as the thermal effects of incendiaries may lead to unnecessary suffering and possibly superfluous injury, so also might the high-energy laser and possibly the particle-beam weapon be suspect when used against unprotected troops in the field. This claim would not apply however, to the use of directed-energy weapons against particular targets which can be more efficiently disabled or destroyed by such devices than with alternative means. For example, it would probably be permissible under Article 35(2) to apply directed-energy weapons against space vehicles, aircraft or even tanks regardless of the fact they may contain crews subject to the adverse physiological effects. Under such circumstances, the suffering would no longer be unnecessary nor the injuries superfluous. This claim for limiting the use of directed-energy weapons, to wit, prohibiting their application in an antipersonnel mode, essentially parallels similar arguments developed through both analogy with

incendiary weapons and the customary and conventional law criteria.

The known characteristics and capabilities of the directed-energy weapon do not seem inherently inconsistent with either Articles 35(3) or 55. The HEL and PBW would not be apt to produce widespread, longterm and severe damage to the natural environment unless intentionally misused to destroy living resources such as forest lands, animals or crops. The absence of the adverse effects of nuclear radiation, uncontrollable biological organisms or highly toxic chemicals characteristic of some weapons of mass destruction, would appear to enhance claims of directed-energy weapon permissibility under these environmental criteria. Simultaneously, these environmental criteria may increase the persuasive impact of claims to the impermissibility of existing weapons of mass destruction which can not be as easily controlled as the HEL or PBW. The probable significance of these articles with respect to the directed-energy weapon is to proscribe intentional use against living resources. When such use is designed to damage the natural environment thereby prejudicing the health or survival of the population, it will be construed as unlawful under Articles 35(3) and 55 of the Protocol.

In addition to the articles providing criteria for claims to weapons control, Article 36 of Protocol I imposes an important new requirement on contracting parties:

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.³³⁷

This provision is designed to emphasize the individual participant's responsibility for developing, testing, producing, deploying and using only weapons which meet the juridical criteria for legality. The significant language "in some or all circumstances" as adopted in Committee II and the Plenary by

by consensus was designed to recognize that limitations on weapon use may be more effective than attempted comprehensive prohibitions. This is apparently consistent with the long-standing U.S. and Western positions which hold limitations on specific uses of weaponry are preferable to broad, general prohibitions *per se*.³³⁸

Of import in this requirement to evaluate new weapons, Committee III to the Diplomatic Conference chose to invoke what might appear to be redundant language, "new weapon, means or method of warfare." This broad language suggests that the contracting party's obligation to ascertain permissibility may arise even prior to the actual research and development of a particular weapons system. It could be argued that at the point where a physical principle itself exhibits potential, it becomes a "means or method of warfare." Since it is generally acknowledged that major power participants have in recent years been considering the possible applications of new physical principles and concepts of warfare, this new requirement may have significant repercussions for programs of basic research and development which previously have been immune from the juridical criteria of weapons control in the international law.

Since October of 1974, the U.S. Department of Defense has had an explicit policy of prospective weapons review. DoD Instruction 5500.15 as implemented in the three major services through specific directives, requires a review of weapon legality in phases including research, development and acquisition.³³⁹ Paragraph IV.A(1) of the DoD Instruction provides:

The legal review will take place prior to the award of an initial contract for production. At such subsequent stages in acquisition or procurement as the Judge Advocate General concerned determines it is appropriate to do so, he may require a further legal review of any weapon.³⁴⁰

Paragraph IV.B further states:

Each DoD Component having primary responsibility for the engineering development, acquisition or production of a weapon will develop and issue internal plans and regulations which will assure that the Judge Advocate General concerned is requested to make the legal review provided for in this Instruction prior to the engineering development and prior to the award of an initial contract for production of that weapon.³⁴¹

Finally, paragraph IV.D provides:

The Director of Defense Research and Engineering will, during the research, development, testing and evaluation phases of the acquisition of a weapon, be responsible for monitoring compliance by DoD Components with Section IV.B of this instruction.³⁴²

While these various provisions clearly provide a program for review of the legality of weapons systems at a relatively early stage in their developmental evolution, they are not as yet in strict compliance with the requirements of Article 36 of Protocol I. Nowhere is there a requirement which would subject the "means and method of warfare" itself to juridical review. In each case, review is tied to a particular weapon or system which has entered at least the research or even engineering developmental phases.

This brief examination of the apparent inadequacies in what may well be the most progressive program of prospective weapons review by any country, seems to underscore the truly innovative features of Article 36 to Protocol I. Never before have participant states been required to actually evaluate not only the legality of specific weapons, but also the more basic "means and methods" of warfare, very possibly including the underlying physical principles used in weapons systems themselves. If participant states in fact implement this article of the Protocol to its fullest logical extent, they will probably be required to undertake prospective reviews of each of the categories of weapons which appear feasible within the broad area of directed-energy weaponry.

A number of other provisions contained in Protocol I may well offer certain indirect bases for claims to limited use of weapons systems. One of

the more apparent bases is contained in the prohibition against indiscriminate attacks upon protected populations. Article 51(4) provides:

Indiscriminate attacks are prohibited. Indiscriminate attacks are:

- (a) those which are not directed at a specific military objective;
- (b) those which employ a method or means of combat which cannot be directed at a specific military objective; or
- (c) those which employ a method or means of combat the effects of which cannot be limited as required by this Protocol.

and consequently, in each such case, are of a nature to strike military objectives and civilians or civilian objects without distinction.³⁴³

Article 51(5) continues by elaborating on what is meant by the terminology "indiscriminate attack":

Among others, the following types of attacks are to be considered as indiscriminate:

- (a) an attack by bombardment by any method or means which treats as a single military objective a number of clearly separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects; and
- (b) an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.³⁴⁴

These provisions introduce a relatively specific prohibition against indiscriminate attack. The rule prominently incorporates the fundamental principles of military necessity and humanity along with their collateral concept of proportionality.

A method or means of combat, possibly including among other things a specific weapon or operative scientific principle inherent in a weapons system, is proscribed if it is so imprecise that it cannot be directed against a specific military objective. While providing an important basis for claims to weapons control, Article 51(5)(b) nevertheless acknowledges that it is permissible to employ the use of a weapon even if ancillary injury or damage results,

so long as such effects are not "excessive in relation to the concrete and direct military advantage anticipated." In other words, the military commander is required under Article 51 to pay close attention to the concept of proportionality between ancillary destruction and the importance of his military objective.

Despite the use of the term "bombardment" in Article 51(5)(a), the open-ended language which immediately follows, "by any methods or means" and the encompassing language of subparagraph (b) would appear to apply to attacks in general. Placed in the context of the entire convention, it is clear that the contracting parties have attempted to draft a comprehensive and generally unqualified set of enforceable protections for noncombatants through this provision. To construe Article 51 so narrowly as to exclude innovative weapons systems would seem in contravention of the intentions of the contracting parties. Hence, based on a general purpose interpretation, a claim could be asserted arguing the rule against indiscriminate attacks on civilian populations applies to most innovative weapons systems including the directed-energy weapon.

The directed-energy weapon is sufficiently controllable and precise as to generally meet the criteria for authorized use established by Article 51(4) and 51(5). Article 51 may nevertheless have the effect of making illegal the use of the directed-energy weapon as a means of coercion available to strategic deterrence forces. The language of Article 51(6), while not invoking the term "retaliation," states "Attacks against the civilian populations or civilians by way of reprisals are prohibited."³⁴⁵ It might be argued that the strategic use of a directed-energy weapon as the means or method of conducting a retaliatory second strike against civilian population centers is not a "reprisal" but more accurately "retaliation."

Despite the generally unqualified language of Article 51, it should also be recalled that the theory of strategic deterrence seems to generally have

the effect of superseding conflicting provisions in the international law of armed conflict. If participant states apply the Royse thesis in conjunction with the customary and conventional law criteria on a comparative basis, they may find directed-energy weapons safer and more efficient than existing nuclear or thermonuclear devices. If this determination is made, directed-energy weapons might be deployed and if necessary used in retaliatory strikes against population centers based on the deterrence strategy, notwithstanding Article 51(6). To transform such a claim into one which is in strict compliance with Article 51 however, it would be necessary for participants to exempt directed-energy weapons from the purview of Protocol I controls as they have done in the case of nuclear weaponry.

There is no evidence to suggest that directed-energy weapons in any way influenced the development of these or other pertinent articles to Protocol I. Records of the four sessions of the Diplomatic Conference suggest that when weapons systems came under discussion, not surprisingly, the focus was upon existing and relatively well understood instruments of coercion. Nevertheless, claims to control of directed-energy weapons based on Protocol I, once it is ratified by participant states, will have a greater chance of acceptance than similar claims which might be grounded upon rules and concepts largely developed prior to the advent of these innovative devices.

Protocol I claims will be supported by a somewhat improved set of enforcement measures set forth in detail in Articles 85 through 91.³⁴⁶ These measures provide for sanctions which include greater personal accountability of military personnel for illegal acts. They encourage mutual assistance between parties in prosecuting violations of the convention. Moreover, the convention establishes an International Fact-Finding Commission in Article 90. This sanctioning system is certainly no panacea, but it does represent progress over the enforcement

mechanisms provided in previous international customary and conventional law.

Whether the various Protocol I claims to weapons control are accepted or rejected by participants will largely be a function of whether they are consistent or inconsistent with exclusive and inclusive interests. The greater the number of exclusive and inclusive values served through a particular institutional basis, the more persuasive the claims arising out of such doctrinal basis.

Protocol I has generally not lost sight of important principles and collateral concepts including military necessity, humanity, efficiency and proportionality. As already noted, these principles and concepts if accurately applied are often consistent with major exclusive interests. Moreover, if participants analytically consider the importance of inclusive interests in avoiding massive deprivation of values and encouraging persuasive resolution of disputes, they may also find Protocol I equally consistent with these interests. Accordingly, claims based on Protocol I as an applicable new institution in the international law will generally have substantial persuasive value in the world community.

2. Prospective Developments in Weapons Control

The international law of armed conflict through customary and conventional criteria provides general guidelines which will probably apply to directed-energy weapons. However, there are at least two significant initiatives underway which could eventually result in controls of explicit application. These initiatives are being respectively keyed to the two generic classifications applicable to instruments of coercion; conventional weapons and weapons of mass destruction. Since it appears that directed-energy weapons have characteristics and capabilities which may qualify them for either or both of these classifications, each of these weapons control initiatives should be briefly considered.

a. *Conventional Weapons.* A forum for developing further, more specific limitations on particular conventional weapons which may cause unnecessary suffering or have indiscriminate effects was established in the early 1970's. The Conference of Government Experts on Weapons that may Cause Unnecessary Suffering or have Indiscriminate Effects, convened at the behest of the ICRC, met in its first session at Lucerne, Switzerland, from September 24 to October 18, 1974.³⁴⁷ Forty-nine states, several national liberation movements, representatives of the Secretary General of the United Nations and of the Director General of the World Health Organizations participated. The Conference was also attended by representatives of a substantial number of private international humanitarian organizations including the National Red Cross and SIPRI.

The purpose of this preliminary conference was to study the question of prohibition or limitation of the use of conventional weapons that may bring about unnecessary suffering or have indiscriminate effects. The Conference had at its disposal a substantial quantity of research data including a series of U.N. studies on various weapons, a SIPRI report on various incendiary devices and a comprehensive Report of Experts issued in 1973 under the auspices of the ICRC. Interestingly enough, the 1973 Report of Experts devoted one of its chapters to future weapons developments and discussed the high-energy laser among other recent innovations.³⁴⁸

Although the 1974 Conference did not go so far as to explicitly classify various innovative weapons systems including the HEL, microwave device or infrasound weapon as necessarily "indiscriminate" or instruments which cause "unnecessary suffering," it clearly considered these and other innovative weapons candidates for possible international control. The Conference report was subsequently considered by the participating governments as well as the Diplomatic Conference. The Conference of Government Experts convened again from

January 28, 1976 to February 26, 1976 at Lugano and at the four sessions of the Diplomatic Conferences on the Reaffirmations and Development of International Humanitarian Law. Although none of these sessions produced a definitive convention addressing particular weapons, the work of the Government Experts was considered in the preparation of Protocols I and II. To this extent it might be said that at least the high-energy laser was known to delegates attending the Diplomatic Conference. In December of 1977, the U.N. General Assembly adopted Resolution 152 (XXXII) dealing with incendiary and other specific conventional weapons.³⁴⁹ Although major participant states including the Soviet Union, United States, the United Kingdom and France abstained, 115 members endorsed the measure without a single negative vote.

The express purpose of Resolution 152 (XXXII) is to establish both a preparatory and plenary U.N. sponsored Conference of Governments to pursue the previous efforts of the Conference of Government Experts. While it is unclear precisely which innovative weapons or concepts will dominate the agenda of the plenary conference in 1979, it appears likely the subject of directed-energy weapons will come under discussion. Whether or not this conference is disposed to imposing substantial controls on directed-energy weapons will clearly depend in large part on the attitudes of those major power participants which are seeking development of such weaponry. What these attitudes may be is still unclear. In any case, it appears there is a good chance the 1979 Conference will provide an important international forum to consider the issue of whether the directed-energy weapon may be classified as "indiscriminate" or an instrument which causes "unnecessary suffering."

b. Weapons of Mass Destruction. A second initiative which may eventually produce controls applicable to directed-energy weapons is an outgrowth of the

United Nations Conference of the Committee on Disarmament. General Assembly Resolutions 3479 (XXX)³⁵⁰ of December 11, 1975 and 74 (XXXI)³⁵¹ of December 10, 1976 requested the Conference of the Committee on Disarmament to develop an agreement on the prohibition of the development and manufacture of new types of weapons of mass destruction and new systems of weapons. Pursuant to these and other mandates, the U.N. Conference of the Committee on Disarmament has issued a report which addresses among other subjects the "prohibition of the development and manufacture of new types and systems of weapons of mass destruction."³⁵²

The Conference report indicates multilateral discussions are well underway on the issue of control over innovative weapons systems. Socialist bloc participants commenting in the report have generally supported the Soviet proposals that a prohibition be developed which would apply to "any types of weapons of mass destruction that were based on qualitatively new principles - according to their mode of use and the targets to be destroyed or the nature of their effects."³⁵³ The Western power views as articulated by the United Kingdom, Canada and the United States questioned the Soviet concept of developing a single treaty on the subject of innovative weapons systems and principles.³⁵⁴ The United Kingdom specifically proposed that the Committee consider negotiating explicit agreements to preclude development of particular new types of weapons of mass destruction which were based on new applications of scientific principles.

Subsequently, the Soviets submitted a revised draft treaty which provided for parallel mechanisms for the prohibition of innovative weapons. The Soviet proposal included a comprehensive agreement on the prohibition of the development and manufacture of new types of systems of mass destruction. The comprehensive agreement, according to the Soviet plan, would contain an annexed list of the specific types of weapons to be prohibited. Secondly, the Soviets proposed the possibility of supplementing the annexed list from time to time

as new weapons are developed. Additionally, they proposed a provision allowing for the possibility of concluding explicit agreements on individual weapons of mass destruction. Such agreements would be considered and negotiated on a case by case basis.³⁵⁵

The United States maintains that the best way to prevent the development and deployment of new weapons of mass destruction is to keep the question under review and draft specific agreements as needed. American delegates particularly stressed the need to tailor verification and enforcement measures to individual weapons systems.³⁵⁶

Discussion in the U.N. report with respect to innovative weapons systems does not address specific weapons in any detail. Nevertheless, the Soviet delegation at one point may have explicitly referred to directed-energy weaponry. In submitting a proposed list of weapons of mass destruction which might appear in the initial annex to their draft comprehensive treaty, the Soviets included the following inventory:

radiological means of the non-explosive type acting with the aid of radio-active materials, technical means of inflicting radiation injury based on the use of charged and neutral particles to affect biological targets, infrasonic means using acoustic radiation to affect biological targets, and means using electromagnetic radiation to affect biological targets.³⁵⁷

In submitting this inventory, the Soviet delegation emphasized that in the opinion of its experts, there exists a sufficient technological basis with regard to these concepts from which to develop weapons of mass destruction.

The proposed Soviet innovative weapons inventory raises at least two questions. First, how broadly do the Soviets construe the concept of "radiological means" and "technical means . . . based on the use of charged and neutral particles"? Are these terms so broadly construed as to possibly include a particle-beam weapon? Second, what is the significance of the Soviet

reference to developing controls with regard to "biological targets"? Does this indicate the Soviets are inclined to oppose restraints on the use of directed-energy or other types of innovative weapons against materiel targets?

The answer to at least the first of these questions has apparently been revealed through disclosures concerning the United States-Soviet negotiations on the control of radiological weapons being conducted in Geneva.³⁵⁸ Since the Fiscal Year 1979 Arms Control Impact Statements have indicated Soviet negotiators have raised the issue of the particle-beam weapon during the course of these talks, it appears they may very well consider this device a type of radiological weapon. If this is the case, Soviet intentions may be to control at least the PBW by means of its inclusion in the proposed annex to the draft convention.

The limited information made public on the discussions of the working group on radiological weapons provides no insight as to Soviet rationale or theory in developing controls limited to the use of innovative weapons against only biological targets. However, it is clear from disclosures that the Soviet proposal to control particle-beam weapons presented in the working group sessions has been keyed to prohibiting only the development and manufacture³⁵⁹ of weapons using "charged and neutral particles to affect biological targets." It may be inferred from this proposed limitation that the Soviets favor claims to the general permissibility of the particle-beam weapon at least when it is developed and manufactured for use against non-biological targets. While the Soviet proposal would ban the use of the PBW as an anti-environment or antipersonnel weapon, it would clearly not affect the many other potential applications of the device including aircraft and missile defense.

United Nations General Assembly Resolutions 84A and 84B (XXXII)³⁶⁰ adopted December 12, 1977, appear to be some of the most recent developments in efforts to formulate controls applicable to directed-energy weapons. Resolution 84A

(XXXII) requests the Conference of the Committee on Disarmament to continue negotiations with the assistance of government experts for the purpose of formulating an agreement on the prohibition of the development and manufacture of new types of weapons of mass destruction. The Conference is directed to submit a report of the results achieved to the General Assembly for consideration at its thirty-third session. The resolution also urges all states to "refrain from any action which would impede international talks aimed at working out an agreement or agreements to prevent the use of scientific and technological progress for the development of new types of weapons of mass destruction and new systems of such weapons."³⁶¹ In addition, the resolution places the topic of control over innovative weapons on the provisional agenda of the thirty-third session of the General Assembly.

Concomitant Resolution 84B (XXXII) reaffirms the 1948 definition of weapons of mass destruction. It specifically urges "states to refrain from developing new weapons of mass destruction based on new scientific principles."³⁶² This resolution requests the Conference of the Committee on Disarmament "to keep under review the question of development of new weapons of mass destruction based on new scientific principles and to consider the desirability of formulating agreements on the prohibition of any specific new weapons which may be identified."³⁶³ Again, the Conference is requested to report back to the thirty-third session of the General Assembly on progress that is made toward developing an international agreement.

It is somewhat unlikely that these developments through the U.N. disarmament apparatus will produce any dramatic new prohibitions or limitations on the directed-energy weapon. Nor is there any suggestion that these resolutions approach the status of binding international law. Nevertheless, they appear to manifest a growing concern on the part of the international community for

the potential threat posed to the minimum world public order system by innovative weapons systems. Moreover, they express the will of the majority of the international community that principal participants pursue appropriate controls for these new weapons. In any case, should the directed-energy weaponry introduced into military arsenals exhibit more the characteristics of weapons of mass destruction as defined under the reaffirmed 1948 definition than of conventional weapons, the United Nations disarmament apparatus is clearly available as a forum for developing whatever controls the participants are prepared to support.

F. Summary

The international law of armed conflict provides three general institutional bases upon which claims bearing on the permissibility or impermissibility of directed-energy weapons may be founded. These bases include a set of criteria developed through the general customary and conventional law principles; analogies with similar weapons systems, principally incendiary weapons, and; certain prospective developments which will soon impact on the law of armed conflict. An analysis of this triad strongly supports the existence of at least certain persuasive claims to the control of directed-energy weaponry.

None of the bases examined suggests the existence of any reliable or credible claim for a comprehensive prohibition *per se* against such key phases or aspects in the weapons evolution as research, development, testing, production, stockpiling, deployment and use of any directed-energy weapon. In certain cases it appears that the bases actually operate to affirmatively authorize the directed-energy weapon as a lawful instrument of coercion. However, it is equally clear that certain claims to limited control have a firm foundation in the law of armed conflict. The claims of greatest persuasive value and which

may very well be under serious consideration by the major participants include those which apply to the use of these weapons against living resources. Related claims may also be evolving with regard to the use of directed-energy weapons against protected noncombatants and their property. A latent exception which would be apt to impact upon these limitations may arise out of any future strategic applications of the directed-energy weapon in major power deterrence forces.

The sanctioning mechanisms in support of these potential claims varies considerably in terms of its reliability and credibility. As in other fields of the international law of armed conflict, enforcement of claims to the limitation of such innovative weapons will include the range of positive and negative sanctions. It is submitted in this study that the strongest factor influencing the acceptance of claims to weapons control is the extent to which claims are consistent with participant exclusive and inclusive interests. From this standpoint, certain claims which tend to impose selective limitations on the use of the directed-energy weapon are persuasive. Typical of such claims would be those seeking to control the use of the directed-energy weapons to ensure that they are not employed in a manner to cause needless suffering, superfluous injury or environmental destruction. Concomitantly, broad based claims, particularly those which fail to take into account the potential attributes of the directed-energy weaponry as a means of avoiding massive deprivation of values, tend to be far less persuasive.

CHALLENGES AND OPPORTUNITIES

All our experience suggests that, as long as there is no dependable comprehensive sanctioning process, states cannot reasonably be expected voluntarily to renounce the use of the most advanced technology in their own defense. An effective community sanctioning process can, further, scarcely hope to dispense with the military instrument. Hence in the search for policies designed to promote minimum order, other and more promising alternatives must be explored.

McDougal, Lasswell, and Vlasic³⁶⁴

The imminent introduction of the directed-energy weapon into the arsenals of the principal powers will represent a challenge to the minimum public order system rivaled only by the development of the atomic and hydrogen bombs. Since the progression of technology can seldom be suppressed and will in its natural course produce dramatic technological breakthrough from time to time, it should be no surprise that once again in this century the world community must address the problems attendant to fundamental change. What is essential at this juncture is that the general silence which surrounds this impending and most important of developments be broken.

In the relatively brief period which remains before the decision-makers must elect from alternative strategies determining the deployment and bases for use of the directed-energy weapon, it is important to thoroughly examine

all its ramifications. Scientists must weigh its effect upon all aspects of the environment. Government leaders must assess its impact upon both national and international policy as well as upon a complex set of social values. Military chiefs should review its projected effects on strategy and tactics. Drawing upon these and many other evaluations, the role of the international lawyer will be to accommodate this new development within the minimum world public order system. It will be his role to ensure that participants maintain an equilibrium throughout the period of adjustment and transition to this new device. Moreover, it will be his professional responsibility to seize upon those claims which best serve the inclusive interests of the world community in pursuing a maximum degree of participant value sharing in an earth-space arena characterized by an absolute minimum of coercion.

Without question, there is an ominous side to the development of such innovative weaponry as the high-energy laser and the particle-beam weapon. Nevertheless, we can ill-afford to ignore the opportunities presented by such events. The world community in the past thirty years has too often ignored opportunities to improve upon the minimum world public order system. While once there might have been a chance to prohibit or limit nuclear or thermonuclear arms, now there is virtually none. At another point we might have avoided the deployment of the strategic ballistic missile with its deadly warheads. These opportunities will not again present themselves. The failure to take advantage of them became a *fiat accompli* when mutual mistrust and fear, closely interwoven with ever stronger commitments to strategic deterrence, forced competing participants to take the next step.

The existence of opportunities and creative policy options is often difficult to perceive under such circumstances. However, the directed-energy device despite its limitations and certain adverse effects upon living resources,

may afford innovative opportunities to all participants seriously interested in pursuing an improved minimum order system. It is time to seriously weigh the establishment of a regime which might advance both the exclusive and inclusive interests of the superpowers through the free and open sharing of technological information pertaining to directed-energy research and development. While the ingrained suspicions and ideological barriers between the socialist states and the Western powers prevent the free exchange of information regarding the dynamics of existing weapons of mass destruction, these participants might nevertheless find it consistent with their respective national security interests to seek a free exchange of information in this relatively independent area of technology.

Guaranteed free flow of technological and developmental information facilitated by credible verification mechanisms could serve to prevent a potentially dangerous situation which may result from an unanticipated deployment by one participant of an innovative device exhibiting capabilities comparable to a weapon of mass destruction. An equally dangerous situation could occur if a participant deploys an innovative device having the capability of neutralizing existing weaponry in its adversary's strategic deterrence forces. Should the deployment of efficient, operational directed-energy weapons create such circumstances, the existing equilibrium between the socialist and Western blocs could rather suddenly be shattered through the failure of a credible deterrent. The participant initiating the sudden deployment of the innovative weaponry, may correctly or incorrectly reach the conclusion that it can effectively mount a preemptive strike against its adversary. Should such event occur, the participant possessing the perceived advantage could seek to impose severe demands contrary to the exclusive interests of its adversary. Worse yet, it could execute the preemptive first strike, in the conviction it would achieve ultimate success at a minimum acceptable cost.³⁶⁵

The complexity of delivery systems and weapons of mass destruction in participant arsenals may appear to minimize the chances of such worst case developments. Nevertheless, technological breakthrough and the development of operational innovative weaponry can not be ignored if for no other reason than its perceived impact upon the minimum public order. While rational and responsible decision-makers could be expected to avoid exploiting a sudden perceived strategic advantage, it is difficult to know how their response might be altered by other influences such as internal political upheaval or severe resource shortages affecting the stability of the social and political order.

The risk of a participant clandestinely achieving a technological breakthrough in innovative weaponry is too great to be ignored. It appears that at least both superpowers either have achieved, or are in the process of attaining, technological breakthroughs in directed-energy weaponry. The risks these efforts pose to the minimum world public order system are such that participants should seriously consider the alternative of entering into a technical if not political based dialogue in an effort to avoid sudden destabilization of the strategic deterrent.

A free and open exchange of information pertaining to directed-energy concepts accompanied by a verification mechanisms may be the most immediately attainable policy goal. Nevertheless, other imaginative policy alternatives present themselves for the longer term. While it is unlikely at this juncture that the major participants would agree to voluntarily arm a multilateral peacekeeping force with existing weapons of mass destruction, agreement might be achieved to vest such supranational authority in progressive stages with ever more potent alternative means of coercive force. Perhaps Professor Gomer's original concept of the "armed arbiter"³⁶⁶ first proposed as an international force equipped with nuclear or biological weapons and ballistic missiles, might be resurrected and armed instead with directed-energy weapons capable of

counteracting strategic delivery systems employed in a preemptive strike. Alternatively, the third party participant could be equipped with directed-energy weapons capable of retaliating against a participant initiating a preemptive strike. The arbiter would have no typical national bases of its own against which to launch a retaliatory strike and therefore could credibly carry out its role at keeping the peace.

Yet another opportunity might arise from the possibility of using the advanced directed-energy weapon as an alternative means of ensuring national security interests while each of the superpowers reduces or eliminates stocks of comparatively less controllable and more dangerous weapons of mass destruction. In the prevailing international climate, there appears considerable doubt that the Strategic Arms Limitation Talks will produce substantial and lasting reductions in nuclear arms or delivery systems, much less total disarmament. No nuclear equipped participant is inclined to seriously limit its arms unless there is some absolute assurance its political independence and territorial integrity will be guaranteed. Although recently developed methods of verification aid in increasing levels of trust and reduce the chance of a surprise preemptive attack, they are probably not sufficient mechanisms by themselves to merit total participant reliance. Indeed the directed-energy weapon might eventually offer the means of achieving the hitherto missing sanctioning instrument. By a phased substitution of comparatively more efficient, controllable and discriminating strategic weaponry in place of environmentally dangerous and often less precise existing weapons of mass destruction, all participants may advance both exclusive and inclusive interests simultaneously.

It is incumbent on decision-makers, and international lawyers in particular, to consider the broad range of challenges and policy options presented by the new generation of directed-energy weaponry. Although this study does not

suppose to suggest any easily attainable or ultimate solution derived from the challenges and opportunities of this new weapon, it argues for an immediate, comprehensive and intellectually objective approach in confronting the problem. Above all in pondering such approach, we should bear in mind that the time for ensuring both the continued equilibrium in the minimum public order system and the full exploitation of the policy options presented, will not be long with us.

FOOTNOTES

¹M. McDougal, H. Lasswell, & I. Vlasic, *Law and Public Order in Space* 360 (1963).

²Woetzel, *Comments on U.S. and Soviet Viewpoints Regarding the Legal Aspects of Military Uses of Space*, Proceedings of the American Society of International Law at its Fifty-Seventh Annual Meeting, 196 (1963). Woetzel speculates as to possible future space weapons demonstrating terrifying potential for destruction. Specifically discussed are the following systems: neutron flux weapons, laser-directed nuclear energy devices, plasma jets heated millions of degrees referred to as "ball lightning" which would be directed by radio waves and so-called environmental counter-value weapons employing large megaton or small gigaton nuclear explosions in space for the purpose of either burning large continental areas or as a defensive shield incinerating incoming strategic weapons delivery systems. *See also*: Willis, *The Militarization of Outer Space*, Current Issues in U.S. Defense Policy 236 (D. Johnson & B. Schneider ed. 1976); *Soviet Killer Satellites: U.S. Ponders a Response*, Science 865 (Sept. 3, 1976); *Targeting a Hunter Killer*, Time, Oct. 17, 1977, at 10; O'Toole, 'Death Ray' Tests Speculated, Wash. Post, Nov. 29, 1977 at A-3.

³Robinson, *Soviets Push for Beam Weapon*, 106 Av. Week and Space Tech. (no. 18) 16 (May 2, 1977). Robinson in a detailed technical analysis considering the possible Soviet development of a charged-particle beam, notes that U.S. officials have coined the term "directed-energy weapons" in referring to both high-energy lasers and the charged-particle beam. *Cf.*: Committee on International Relations & Committee on Foreign Relations, *Fiscal Year 1979 Arms Control Impact Statements: Statements Submitted to the Congress by the President Pursuant to Section 36 of the Arms Control and Disarmament Act*, 95th Cong., 2d Sess. 224-33 (Jun. 1978) (hereinafter cited as: *Fiscal Year 1979 Arms Control Impact Statements*). The 1979 Arms Control Statements suggest that high-energy lasers may be considered in a separate category from directed-energy weapons. The directed-energy weapon category in this report is specifically applied to the particle-beam weapon. The present study prefers to employ the broad generic category used by Robinson which includes both the particle-beam weapon and the high-energy laser in the classification of directed-energy weapons.

⁴Beane, *The High-Energy Laser: Strategic Policy Implications*, Strategic Review 100 (Winter 1977).

⁵Klass, *Special Report: Laser Weapons-3: Current Systems Still More Cost-Effective*, Av. Week and Space Tech. 58 (Sept. 8, 1975) (hereinafter cited as Klass, *Special Report: Laser Weapons-3*). Klass notes that certain kinds of lasers, particularly the promising chemical laser, operate best with lasing

cavities at very low pressures and temperatures. These conditions can be naturally supplied in the near vacuum of space. In addition, lasers which use gases which are extremely toxic and corrosive in the atmosphere may present little or no problem in space.

⁶Beane, *supra* note 4, at 101.

⁷While the U.S. Department of Defense acknowledges the high-energy laser's weapons potential, it continues to hold to the position the device has not as yet been proven to be cost-effective. In *Fiscal Year 1979 Arms Control Impact Statements*, *supra*, 3, at 228, it is observed: "The high energy laser represents important new technology with many potential weapon applications. However, specific applications of the HEL may prove difficult and some applications may not be cost effective even if they become feasible."

⁸Beane, *supra* note 4, at 101.

⁹*Id.* at 101. See generally Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 53 for comprehensive discussion on various applications of the high-energy laser or HEL in the field of military weaponry.

¹⁰Beane, *supra* note 5, at 102.

¹¹*DOD Continues Satellite Blinding Investigation*, Av. Week and Space Tech. 18 (Jan. 5, 1976). This unsigned article notes that the Soviets in their experiments are believed running about even with the U.S. in some areas of laser technology and slightly ahead in generating power for HEL applications. The article notes Soviet lasers have been tested at Semipalatinsk. See also: Av. Week and Space Tech. 19 (Apr. 21, 1975). However, the principal article referenced contends that while the Soviets may as of the date of its publication (January 1976) possess a high-energy laser capable of "blinding" U.S. reconnaissance satellites, the United States could have similar capability within six months to a year if it chose to follow suit. See Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 58.

¹²*U.S. Funds Killer Satellite Effort*, 108 Av. Week and Space Tech. (no. 6) 18 (Feb. 6, 1978).

¹³*Id.* at 18.

¹⁴Willenson, Clark & Norman, *Arms Race in Space*, Newsweek, Feb. 13, 1978, 53 at 55.

¹⁵See generally: Miller, *USAF Pushes Satellite Survivability* 106 Av. Week and Space Tech. (no. 13) 52-54 (Mar. 28, 1977) for discussion on various U.S. programs and contracts oriented toward evaluation of the laser as well as the development of effective countermeasures against laser attack. See also:

Klass, *Special Report: Laser Weapons: Advanced Weaponry Research Intensifies*, Av. Week and Space Tech. 34 (Aug. 18, 1975) (hereinafter cited as: Klass, *Special Report: Laser Weapons: Advanced Weaponry Research Intensifies*); Klass, *Special Report: Laser Weapons-2: Pentagon Seeks to Channel Research*, Av. Week and Space Tech. 50 (Sept. 1, 1975) (hereinafter cited as: Klass, *Special Report: Laser Weapons-2*); and Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 58 for additional discussion on various U.S. research and development programs.

¹⁶ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 225. The statement addressing U.S. high-energy laser programs notes:

The DOD HEL programs are in an early R. & D. state, wherein the potential application of this new technology to defense missions is still being explored. No prototype weapons have been decided upon, and indeed the practical potential of HEL (compared with other weapons) *within the Earth's atmosphere* has not yet been convincingly demonstrated. (emphasis added)

This statement implies continued doubts regarding the application of the HEL in the atmospheric or terrestrial theaters. It does not however, seem to rule out the imminent application of the HEL as a weapon in the near space theater.

¹⁷ Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 58.

¹⁸ *Id.* at 58.

¹⁹ Klass, *Special Report: Laser Weapons: Advanced Weaponry Research Intensifies*, *supra* note 15, at 34.

²⁰ Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 53.

²¹ *Id.* at 53-59. See also various sources cited *supra* note 5.

²² Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 59.

²³ Klass, *Progress Made On High Energy Laser*, 106 Av. Week and Space Tech. (no. 10) 16 (Mar. 7, 1977).

²⁴ International Committee of the Red Cross, *Weapons That May Cause Unnecessary Suffering or Have Indiscriminate Effects: Report on the Work of Experts*, 67-68, para. 237(a), (Geneva 1973) (hereinafter cited as: ICRC 1973 Report).

²⁵ Klass, *Special Report: Laser Weapons-2*, *supra* note 15, at 50.

²⁶ *Id.* at 53.

²⁷ ICRC 1973 Report, *supra* note 24, at 68, para. 237(a).

²⁸ Willenson & Clark, *War's Fourth Dimension*, Newsweek, Nov. 29, 1976, 46 at 47.

²⁹ Klass, *Special Report: Laser Weapons-2*, *supra* note 15, at 54.

³⁰ Beane, *supra* note 4 at 103-04. Beane in his article on the strategic policy implications of the high-energy laser discusses how the unique characteristics of the device might impact on the conduct of warfare. He argues that a HEL, coupled with a radar system, could be developed to provide instantaneous detection and destruction of bombers or missiles:

So quick is the laser that only one, tracking and beaming on radar, could pick off descending multiple warheads in miniseconds. The lasers' swiftness would permit defenders to detonate missiles far down-range from the missiles' targets. In tests, high-energy lasers have burned through the nose cones of missiles built to withstand the scorching searing heat of reentry from space

See also: Fiscal Year 1979 Arms Control Impact Statements, *supra* note 3, at 224 for comment on the laser's capability of transmitting energy to its target instantaneously.

³¹ ICRC 1973 Report, *supra* note 24, at 68, para. 238.

³² Beane, *supra* note 4, at 102.

³³ Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 57.

³⁴ *Id.* at 53.

³⁵ Klass, *Special Report: Laser Weapons: Advanced Weaponry Research Intensifies*, *supra* note 15, at 39.

³⁶ ICRC 1973 Report, *supra* note 24, at 69, para. 241. *See also: infra* p. 129 & note 286.

³⁷ Klass, *Special Report: Laser Weapons: Advanced Weaponry Research Intensifies*, *supra* note 15, at 37-38.

³⁸ *Id.* at 37-38.

³⁹ *Id.* at 34-36.

⁴⁰ *Id.* at 35.

⁴¹*Id.* at 36.

⁴²*Id.* at 36.

⁴³O'Toole, *Space Wars: Laser-Armed Killer Satellites, False Signals Worry Pentagon*, Wash. Post, Nov. 6, 1977, at C-1 & C-4. *Accord*: Interview with Philip J. Klass Av. Week and Space Tech., McGraw-Hill Inc., Rm 425, National Bldg., Washington, D.C. (Jun. 9, 1978).

⁴⁴Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 53-59. *Accord*: Interview with Klass *supra* note 43.

⁴⁵Klass, *Progress Made on High Energy Laser*, *supra* note 23, at 16.

⁴⁶Interview with Klass, *supra* note 43.

⁴⁷O'Toole, *supra* note 43, at C-4.

⁴⁸*Id.* at C-4.

⁴⁹Beane, *supra* note 4, at 106.

⁵⁰*Supra* pp. 5-6.

⁵¹*Toward Laser Weapons in Space*, III Sci. News (no. 10) 158 (Mar. 5, 1977).

⁵²Beane, *supra* note 4, at 102.

⁵³Siekman, *The Fantastic Weaponry*, in *Reflections on Space* 257, 258-59 (O. Rechtschaffen, U.S.A.F. Academy Colorado ed. 1964) (Excerpts reprinted from Jun. 1962 issue of *Fortune Magazine*, 156-59, 214, 216, 218, 223-24, copyright (C) 1962, Time Inc.). Siekman invokes the term "near space" in discussing the "envelope of nothing that extends from 100 to 25,000 miles out from earth." He observes that Air Force General Bernard A. Schriever, head of AF Systems Command with principal responsibility in the early 1960's for the U.S. military space development, as well as other military planners, considered "near space" an "open flank." General Schriever expressed concern that the U.S. was not in a position to defend this "open flank." According to Siekman, General Schriever was one of the first to indicate a belief that men and weapons operating in space could influence the balance of military power on earth.

⁵⁴Beane, *supra* note 4, at 104-06. *See generally*: Willenson & Clark, *War's Fourth Dimension*, *supra* note 28, at 46-48.

⁵⁵ J. Canan, *The Superwarriors, The Fantastic World of Pentagon Super-
weapons*, 253 (1975) *quoted in* Beane, *supra* note 4, at 100.

⁵⁶ Statement of George H. Heilmeier, Director, U.S. Defense Department
Advance Research Projects Agency (hereinafter referred to in text and footnotes
as simply ARPA) before House Armed Services Committee *reprinted in: Toward
Laser Weapons in Space* III Sci. News (no. 10) 158 (Mar. 5, 1977).

⁵⁷ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 227.

⁵⁸ *Id.* at 226-27. The arms control impact statement applicable to high-
energy lasers provides this observation regarding the weapon's effect on global
or regional stability:

It is not possible at this time to be definitive as to the impact
of the U.S. HEL program on global stability. On the one hand, it is
conceivable that by injecting additional uncertainties into future
military projections, HEL programs could adversely affect global or
regional stability. In particular, the U.S. (and Soviet) HEL programs
could encourage other countries to initiate or expand similar programs.
Technological innovation is a central feature of the East-West military
competition. (deleted). Thus, new technologies like HEL weapons could
make progress in arms control more difficult and contribute to uncertainty
and instability in global and regional interrelations. On the other
hand, if a nation believes an adversary is obtaining an advantage in
weaponizing a new technology, there could be incentives to constrain
this advantage through negotiation of an arms control agreement. For
example, the ABM Treaty may have been viewed by the U.S.S.R. as a way
to limit deployment of a technologically superior U.S. ABM system.

⁵⁹ Douglas & Thomsen, *The Great Russian 'Death-Beam' Flap*, III Sci.
News (no. 21) 329 & 334-35 (May 21, 1977). Douglas and Thomsen discuss the
debate between those who believe a Soviet charged-particle beam is imminent
and those doubting the development of such capability. They generally
express reservations about the Robinson and Keegan claims that a Soviet techno-
logical breakthrough has occurred. *Compare: Fiscal Year 1979 Arms Control
Impact Statements*, *supra* note 3, at 229-33 where the U.S. Government seems to
be acknowledging that official Soviet and American research and development
programs have been oriented to exploring the possibility of particle-beam
weaponry.

⁶⁰ Douglas & Thomsen, *supra* note 59, at 329-30.

⁶¹ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 229.

⁶² *See generally*: Douglas & Thomsen, *supra* note 59, at 329, 334-35;
Robinson, *supra* note 3, at 16-23. The Robinson article provides an exhaustive
description of a charged-particle beam test weapon and discusses alleged Soviet
efforts to perfect this device.

⁶³Robinson, *supra* note 3, at 16.

16. ⁶⁴Douglas & Thomsen, *supra* note 59, at 334; Robinson, *supra* note 3, at

⁶⁵Robinson, *supra* note 3, at 17.

⁶⁶*Id.* at 16.

⁶⁷*Id.* at 16.

⁶⁸O'Toole, 'Death Ray' Tests Speculated, *supra* note 2 at A-3.

⁶⁹*Id.* at A-3.

⁷⁰*Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 229.

⁷¹*Id.* at 229.

⁷²Robinson, *supra* note 3, at 18.

⁷³*Fiscal Year 1979 Arms Control Statements*, *supra* note 3, at 229-30.

⁷⁴*Id.* at 230.

⁷⁵Robinson, *supra* note 3, at 22.

230. ⁷⁶*Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at

⁷⁷Robinson, *supra* note 3, at 22.

230. ⁷⁸*Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at

⁷⁹Douglas & Thomsen, *supra* note 20 at 334.

⁸⁰*Id.* at 334.

⁸¹Robinson, *supra* note 3, at 22.

⁸²Douglas & Thomsen, *supra* note 59, at 334.

⁸³*Id.* at 334.

⁸⁴*Id.* at 334.

⁸⁵Robinson, *supra* note 3, at 21.

⁸⁶Douglas & Thomsen, *supra* note 59, at 334.

⁸⁷*Id.* at 334.

⁸⁸*Debate Seen on Charged-Particle Work*, 106 Av. Week and Space Tech. (no. 18) 17 (May 2, 1977).

⁸⁹Hotz, *Beam Weapon Threat* 106 Av. Week and Space Tech. (no. 18) 11 (May 2, 1977)(editorial).

⁹⁰*Contra: Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 232-33. The arms control statement pertaining to directed-energy weapons expresses little significant concern for Soviet achievements and observes "Currently the foreign achievements in PBW do not appear to threaten U.S. national security."

⁹¹International Committee of the Red Cross, Conference of Government Experts on the Use of Certain Conventional Weapons, 77, para. 277 (1975) (hereinafter referred to as the ICRC 1975 Report).

⁹²McDougal, Lasswell & Vlasic, *supra* note 1, at 407.

⁹³*Id.* at 103.

⁹⁴*Id.* at 102.

⁹⁵*Id.* at 407.

⁹⁶A Consideration of the contemporary law of strategic arms control in the present study has been incorporated as an element of the comprehensive international law applicable to the earth-space arena. It is recognized that some legal analysts would classify this particular body of law as part of the law of armed conflict, considered in Chapter IV of this study. However, since the law of armed conflict typically applies constraints to participants during the actual conduct of coercion and since arms control agreements are designed to function in times of peace, this study has included this body of law under the comprehensive international law. This study submits that the law of arms control is more appropriately classified as part of the general international law operative in times of peace.

⁹⁷ McDougal, Lasswell & Vlasic, *supra* note 1, at 3-192. This source offers an exhaustive consideration of the processes of interaction, claim and decision operative in the earth-space arena. It also discusses in detail various inclusive and exclusive participant interests.

⁹⁸ *Id.* at 400. Authors reference material from statement by Professor Leon Lipson at the Fourth Seminar on the Law of Outer Space, reported in 5 Int'l and Comp. 1. Bull. 17, 18 (May 1961).

⁹⁹ The Treaty on Principles Governing Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to in textual material and footnotes as the Outer Space Treaty, or simply, the Treaty) Jan. 27, 1967, 18 U.S.T. 2460, T.I.A.S. No. 6347, 610 U.N.T.S. 205 (entered into force for U.S. Oct. 10, 1967).

¹⁰⁰ J. Kemp, Evolution Toward A Space Treaty 3-4 (Sept. 1966) (paper written for National Aeronautics and Space Administration's summer seminar on "History, Social Science and Space" and printed by NASA Historical Staff, Office of Policy Analysis, NASA, Washington, D.C.) (Manuscript located in U.S. Army Pentagon Library, Washington, D.C.).

¹⁰¹ *Id.* at 4 & 4 n. 2.

¹⁰² *Id.* at 4 & 4 n. 3.

¹⁰³ *Id.* at 6 & 6 n. 9.

¹⁰⁴ Regulation, Limitation and Balanced Reduction of All Armed Forces and All Armaments, Conclusion of an International Convention (Treaty) on the Reduction of Armaments and the Prohibition of Atomic, Hydrogen and Other Weapons of Mass Destruction, G.A. Res. 1148 (XXII) U.N. GAOR, Supp. (No. 18) 3-4, U.N. Doc. A/3805 (1957) (adopted by the 1st Committee).

¹⁰⁵ Kemp, *supra* note 100, at 7-9.

¹⁰⁶ *Id.* at 12 & 12 n. 23.

¹⁰⁷ *Id.* at 22 & 22 n. 46.

¹⁰⁸ *Id.* at 22; *See also*: Question of Peaceful Use of Outer Space, G.A. Res. 1348 (XIII) U.N. GAOR, Supp. (No. 18) 5-6, U.N. Doc. A/4090 (1958) (adopted by the 1st Committee).

¹⁰⁹ Kemp, *supra* note 100, at 37-38.

¹¹⁰ *Id.* at 38. *See also*: O. Ogunbanwo, International Law and Outer Space Activities 12-14 (1975). Text provides detailed chronology of early actions by U.N. General Assembly to establish comprehensive legal regime applicable to

the outer space arena.

¹¹¹Kemp, *supra* note 100, at 42 & 42 n. 45.

¹¹²*Id.* at 45 & 45 n. 51.

¹¹³*Id.* at 47.

¹¹⁴International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1721 (XVI) U.N. GAOR, Supp. (No. 17) 6-7, U.N. Doc. A/5100 (Dec. 20, 1961)(adopted on the reports of the 1st Committee).

¹¹⁵Kemp, *supra* note 100 at 62-65. *See also*: McDougal, Lasswell & Vlasic, *supra* note 1 at 462-66.

¹¹⁶*Id.* at 66-67 & 67 n. 30.

¹¹⁷*Id.* at 66-67 & 67 n. 29.

¹¹⁸International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1802 (XVII) U.N. GAOR, Supp. (No. 17) 5-7, U.N. Doc A/5217 (Dec. 14, 1962).

¹¹⁹U.S. Arms Control and Disarmament Agency, Arms Control and Disarmament Agreements: Texts and History of Negotiations 46 (Jun. 1977)(hereinafter referred to as the ACDA Agreements).

¹²⁰Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (hereinafter referred to in textual material as the Nuclear Test Ban Treaty) Aug. 5, 1963, T.I.A.S. No. 5433, 480 U.N.T.S. 43. (entered into force for U.S. Oct. 10, 1963).

¹²¹ACDA Agreements, *supra* note 119, at 46.

¹²²Question of General and Complete Disarmament, G.A. Res. 1884 (XVIII) U.N. GAOR, Supp. (No. 15) 13, U.N. Doc. A/5515 (Oct. 17, 1963)(item 26)(A/5571) (adopted on the report of the 1st Committee).

¹²³Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962 (XVIII) U.N. GAOR, Supp. (No. 15) 15-16, U.N. Doc. A/5515 (Dec. 13, 1963)(adopted on the reports of the 1st Committee). For general discussion regarding import of this resolution, *see* Ogunbanwo *supra* note 110, at 12-14.

¹²⁴*Id.* para. 1.

¹²⁵*Id.* para. 4.

¹²⁶Kemp, *supra* note 100, at 59 n. 11.

¹²⁷International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1963 (XVIII) U.N. GAOR, Supp. (No. 15) 16-17, U.N. Doc. A/5515 (Dec. 13, 1963).

¹²⁸Kemp, *supra* note 100 at 97-105.

¹²⁹International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 2130 (XX) U.N. GAOR, Supp. (No. 14) 10-11, U.N. Doc. A/6014 (Dec. 21, 1965). *See also*: Kemp *supra* note 100, at 106 & 106 n. 1.

¹³⁰Kemp, *supra* note 100, at 106 & 106 n. 1.

¹³¹*Id.* at 109-11.

¹³²U.S. Draft Space Treaty: Treaty Governing the Exploration of the Moon and Other Celestial Bodies, (Jun. 16, 1966) *reprinted in* Kemp, *supra* note 100, at 205, 207 art. 8. *See also*: Dept. of State Celestial Bodies Chronology, May 11, 1966.

¹³³*Id.* at 207, art. 8.

¹³⁴U.S.S.R. Draft Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, the Moon and Other Celestial Bodies, (Jun. 16, 1966) *reprinted in* Kemp, *supra* note 100, at 211, 213 art. IV. *See also*: U.N. Doc. A/6341 (May 31, 1966).

¹³⁵Kemp, *supra* note 100, at 122.

¹³⁶ACDA Agreements, *supra* note 119, at 46.

¹³⁷Outer Space Treaty, *supra* note 99.

¹³⁸*Id.* Preamble.

¹³⁹*Id.* Preamble referencing both UNGA Res. 1962 (XVIII) and UNGA Res. 1884 (XVIII).

¹⁴⁰*Id.* art. III.

¹⁴¹Ogunbanwo, *supra* note 110, at 33-34.

¹⁴²*Id.* at 23-30. *See also*: Dembling & Arons, *The Evolution of the Space Treaty* 33 J.A.L.C. 402, 433-34 (1967).

¹⁴³Dembling & Arons, *supra* note 54, at 433-34.

¹⁴⁴Ogunbanwo, *supra* note 110, at 100-01. *See also*: The Antarctic Treaty, Dec. 1, 1959, T.I.A.S. No. 4780, 12 U.S.T. 794, 402 U.N.T.S. 71, 54 Am J. Int'l L. 476 (1960) (entered into force for U.S. Jun. 23, 1961).

¹⁴⁵Outer Space Treaty, *supra* note 99, art. IV.

¹⁴⁶*See*: Ogunbanwo, *supra* note 110, at 30-31 observes that Article IV(2) of the Treaty implicitly authorizes various types of military activities in space: "Furthermore, Article IV of the Space Treaty gives the impression that the establishment of military bases, installations and fortifications, the testing of any types of weapons and the conduct of military manoeuvres are permitted in outer space." *See also*: Gorove, *Arms Control Provisions in the Outer Space Treaty: A Scrutinizing Reappraisal*, 3 Ga. J. Int'l. & Comp. L. 114, 118-23 (Issue 1, 1973).

¹⁴⁷Ogunbanwo, *supra* note 110, 30 n. 42. Unidentified Secretary General of the United Nations *quoted by* Ogunbanwo citing source A/PX 1499, p. 72.

¹⁴⁸*Id.* at 98-100. Ogunbanwo recounts the Italian proposal of September 9, 1968 which requested that the agenda of the Twenty-Third General Assembly consider the necessity of amending Article IV of the Outer Space Treaty. The Italian proposal specifically noted such "loopholes" as the absence of a prohibition against the orbiting of weapons of mass destruction around the moon and other celestial bodies, the absence of any prohibition against nuclear and other weapons of mass destruction in semi-orbits and the absence of a proscription against such devices on board sounding vehicles moving toward deep space. The United Kingdom, Soviet Union and United States responded to the Italian proposals by noting their understanding that the Treaty essentially already applied to the matter of weapons in lunar orbit or in deep space. In view of this assurance and apparent lack of major power support for a change in the Treaty, Italy ultimately withdrew its proposal.

¹⁴⁹Outer Space Treaty, *supra* note 99, art. IV(1).

¹⁵⁰G.A. Res. 1884 (XVIII), *supra* note 122.

¹⁵¹*Supra* pp. 53-54. *See generally*: Kemp, *supra* note 100, at 79-132.

¹⁵²Ogunbanwo, *supra* note 110, at 92.

¹⁵³*Treaty on Outer Space, Hearings on Foreign Relations, United States Senate*, 90th Cong. 1st Sess. on Executive D, (Mar. 7, 13 & Apr. 12, 1967) at 76-77 (testimony by Ambassador Arthur Goldberg) and at 100 (testimony of Assistant Secretary of Defense Cyrus Vance). It is interesting that subsequent to Ambassador Goldberg's testimony, Mr. Vance, then Assistant Secretary of Defense in the Johnson Administration, appeared before the same committee and was asked by Senator Cooper to provide a statement about weapons of mass

destruction. Mr. Vance replied "yes, I believe it (the Treaty definition of weapons of mass destruction) would include such other weapons systems as chemical and biological weapons, sir, or any weapon which might be developed in the future which would have the capability of mass destruction such as that which would be wreaked by nuclear weapons."

¹⁵⁴Nossiter, *Conventional Arms Overlap Nuclear on Scale of Deadliness*, Wash. Post, Jul. 1, 1978, at F-1. Washington Post Foreign Service writer Bernard D. Nossiter in this article notes "The killing power of modern conventional weapons has increased so rapidly that the deadliest are now more powerful than the smaller nuclear weapons." Nossiter observes that the pre-existing "threshold" between nuclear and conventional weapons has been breached in consequence of such recent additions to conventional arsenals as high explosive fragmentation grenade clusters and high explosive blockbuster bombs. He recounts an interesting measure of lethality devised by Colonel T.N. Depuy in 1964. Sussex University scientist Julian Perry Robinson has used the Depuy "lethality index" to measure some twenty-six weapons ranging from the broadsword to a one-megaton hydrogen or fusion bomb. The results of the Robinson study have been published in the *Bulletin for Atomic Scientists* and indicate that at least some conventional weapons now appear to exceed certain tactical nuclear weapons on the index. In view of these findings, there may be genuine question as to the logical validity of analyses which automatically assume all nuclear and other weapons of mass destruction are *per se* more destructive and injurious than existing conventional weapons.

¹⁵⁵Resolution of General Assembly Commission for Conventional Armaments, S/C. 3/32 Rev. 1 and Rev. 1/Corr. 1 (Aug. 12, 1948) *cited in* Prohibition of the Development and Manufacture of New Types of Weapons of Mass Destruction and New Systems of Such Weapons, G.A. Res. 84B (XXXII) (Dec. 12, 1977)(published in United Nations Press Release GA/5723 Jan. 5, 1978 at 107)(available at Office of Public Information Press Section, U.N. Building, New York City, N.Y. & U.N. Information Center and Library, Washington, D.C.).

¹⁵⁶G.A. Res. 84B (XXXII), *supra* note 155.

¹⁵⁷Nossiter, *supra* note 154, at F-1.

¹⁵⁸Beane, *supra* note 4, 104.

¹⁵⁹Orr, *The Treaty on Outer Space: An Evaluation of the Arms Control Provisions*, 7 Colum. J. of Transnat'l. L. 259-78 (Spring 1968).

¹⁶⁰*Id.* at 276.

¹⁶¹*Id.* at 276-77.

¹⁶²*Id.* at 277. Orr references *Loopholes Seen in Space Treaty*, Sci. News 565-66 both as source recording Meek's statement and discussing possible "atomic heat ray" proposed by Dr. Arthur Kantrowitz, head of Avco-Everett Company.

¹⁶³Gorove, *supra* note 146, at 115-16.

¹⁶⁴*Id.* at 116.

¹⁶⁵Wilson, *Brown Says Some U.S. Satellites Are Vulnerable to Soviet Hunters*, Wash. Post, Oct. 5, 1977, at A-2. Wilson discusses current U.S. Air Force efforts involving the expenditure of \$58.7 million to construct a "flying tomato can" which would lock onto enemy satellites in space and destroy them through collisions at an orbital speed of 17,500 miles an hour. He also observes that Soviet tests of satellite killers indicate Russian ASAT mechanisms may operate by sending a vehicle into space which closes on its prey and then detonates a nonnuclear explosive in the vicinity of the target.

¹⁶⁶Gorove, *supra* note 146, at 120.

¹⁶⁷Orr, *supra* note 159, at 274. See also: ACDA Agreements, *supra* note 119, at 45-46 which offers little guidance as to the interpretation of key provisions in the Outer Space Treaty. A survey of U.S. Department of State files with respect to the *travaux-preparatoires* reveals little unclassified material which bears on interpretation of key Treaty language.

¹⁶⁸Leavitt, *FOBS: It Shouldn't Be Any Surprise*, A.F. Space Dig. 71, 72 (Dec. 1967). Leavitt offers detailed discussion of early Soviet FOBS development and testing. See also: Schrader, *Defense in Outer Space* 49 Mil. L. Rev. 157, 161 (Jul. 1, 1970).

¹⁶⁹Orr, *supra* note 159, at 274 n. 108 in which N.Y. Times, Nov. 5, 1967, at 30, col. 1 cited. Orr observes "reports of the draftsmen's comments (Treaty draftsmen) both prior to and following adoption of the Treaty fail to reveal any discussion of this or any other definition of "in orbit." *id.* at 274.

¹⁷⁰*Id.* at 274 n. 109.

¹⁷¹Gorove, *supra* note 146, at 116; *supra* p. 68 & n. 164.

¹⁷²Orr, *supra* note 159, at 274 n. 106 in which N.Y. Times, Nov. 4, 1967, at 1 col. 8 cited.

¹⁷³Leavitt, *supra* note 168, at 71. DOD Release 1060-67, Nov. 3, 1967 (Sec'y McNamara) reprinted in N.Y. Times, Oct. 17, 1967, at 1 also reprinted in S. Lay & H. Taubenfeld, *The Law Relating to Activities of Man in Space* 27 (1970). Former Secretary of Defense, Robert McNamara, appearing before a Congressional Committee in the fall of 1967, testified that Soviet testing of the FOBS did not appear to constitute a violation of the Outer Space Treaty. McNamara's position as presented to the committee was that so long as the Soviets did not actually carry a nuclear device into space or detonate it, neither the Test Ban Treaty of 1963 nor the Outer Space Treaty were violated.

¹⁷⁴Orr, *supra* note 146, at 275.

¹⁷⁵Outer Space Treaty, *supra* note 99, art. IV(1).

¹⁷⁶*Id.* art. IV(1).

¹⁷⁷*Id.* art. IV(2).

¹⁷⁸*Id.* art. IX.

¹⁷⁹Willenson & Clark, *supra* note 28, at 46-48; Willenson, Clark & Norman, *supra* note 14, at 53 & 55.

¹⁸⁰Willenson, Clark & Norman, *supra* note 14, at 53 & 55.

¹⁸¹Treaty Between the United States of America and the Union of the Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (hereinafter referred to in textual materials and footnotes as the ABM Treaty, or, simply as the Treaty) May 26, 1972, 23 U.S.T. 3455, T.I.A.S. No. 7505 (entered into force for U.S. Oct. 3, 1972).

¹⁸²*Id.* art. I.

¹⁸³*Id.* art. II(1).

¹⁸⁴*Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 231. Where the bracketed word "deleted" appears in this quotation and those which follow, portions of the original report authored by the executive branch have been censored by the Congressional Committee staffs to permit publication on an unclassified basis. This study has not had access to the classified portion of this report or other classified information.

¹⁸⁵*Id.* at 226. Any portion of the statement originally contained under the heading, "Consistency with Agreed Arms Control Obligations" has been deleted for reasons of U.S. national security.

¹⁸⁶Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms with Protocol, (hereinafter referred to in textual material and footnotes as the Interim Agreement or the Protocol as appropriate) May 26, 1972, 23 U.S.T. 3462, T.I.A.S. No. 7504 (entered into force Oct. 3, 1972), Protocol, 1 Agreed Interpretations, ABM Treaty [E] .

¹⁸⁷ABM Treaty, *supra* note 181, arts. XIII & XIV.

¹⁸⁸*Id.* art. V(1).

¹⁸⁹*Id.* art. XII(1) & (2).

¹⁹⁰Interim Agreement, *supra* note 186, art. V.

¹⁹¹Klass, *Anti-Satellite Laser Use Suspected*, 103 Av. Week and Space Tech. (no. 23) 2-3 (Dec. 8, 1975). See also: *DOD Continues Satellite Blinding Investigation*, *supra* note 11, at 18.

¹⁹²Klass, *supra* note 191, at 12-13.

¹⁹³*DOD Continues Satellite Blinding Investigation*, *supra* note 11, at 18. See also: *2 Magazines Say Soviet Lasers Destroyed a U.S. Space Satellite*, N.Y. Times, Nov. 23, 1976, at 17.

¹⁹⁴Klass, *supra* note 191, at 2-3. Klass cross references an article in *Aviation Week and Space Technology* at 156 (Jun. 22, 1970) for further details on U.S. Air Force development of low-power laser radar during the 1960's. He notes this laser radar was designed to "interrogate" satellites.

¹⁹⁵Klass, *supra* note 191, at 3.

¹⁹⁶Interview with Dr. Donald Hafner, U.S. Arms Control and Disarmament Agency, Dept. of State Bldg. Washington, D.C. 0900-1045 Feb. 21, 1978, See *DOD Continues Satellite Blinding Investigation*, *supra* note 11, at 18.

¹⁹⁷U.S. Arms Control and Disarmament Agency, *Compliance With the SALT One Agreements*, 1, at 12-13 (No. 78-4, Washington, D.C. Feb. 21, 1978) (press release) (hereinafter cited as ACDA Release No. 78-4).

¹⁹⁸O'Toole, *supra* note 43, at C-4. Thomas O'Toole in a November 1977 article in the *Washington Post* on laser-armed satellites speculates as to some of the implications of a sudden disappearance of one or more satellites:

At a time when the satellite population is burgeoning, few experts know the outcome of an unprovoked attack in space. If one satellite were attacked there might be no response for lack of proof. But the 'disappearance' of two or three satellites might provoke a hostile response.

'The loss of more than one satellite to an attack would be viewed in either Moscow or Washington with considerable alarm,' one source close to the Central Intelligence Agency said. 'It might take away one country's ability to police treaties like SALT and it could lead to a very cold resumption of the Cold War, replete with space gap theories and the like.'

O'Toole is probably correct in assuming that should several mysterious

disappearances suddenly occur, a participant would be apt to infer an intentional attack had occurred against its resources. Such a participant would typically suspect any adversary which had major space resources available to it. In the case of the two superpowers, each would be inclined to suspect that the other had destroyed or disabled its satellites. Unfortunately, there may in certain instances be no easy way in which to confirm whether an attack has actually occurred in fact or whether satellite disappearance is the result of some other cause. Hence it will be necessary for participants to avoid too quickly reacting to such losses or incapacitation of satellite resources. It may be equally important that participants not take advantage of the possibility of destroying an adversary's space resources without detection.

¹⁹⁹ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 224-33. While the statements relating to the HEL and PBW predict no immediate threat to the minimum public order, they nevertheless acknowledge that innovative weaponry could eventually impose a strain on the existing arms control regime. The high-energy laser program statement provides:

It seems likely that as the technology of high energy laser weapons matures for both ourselves and the Soviets, it may raise some significant challenges to our arms control interests. Thus, though the HEL related R. & D. efforts funded in this fiscal year 1979 budget probably have no more than marginal arms control effects, this technology deserves continuing attention. *id.* at 228.

²⁰⁰ *Klass*, *supra* note 191, at 3.

²⁰¹ *Supra* p. 81. See also: ABM Treaty, *supra* note 181, arts. XIII
XIV.

²⁰² ABM Treaty, *supra* note 181, art. XIII.

²⁰³ ABM Treaty, *supra* note 181, art. XIV.

²⁰⁴ Interview with Hafner, *supra* note 196. See: ACDA Release No. 78-4, 197 at 11 para. IV(D) which provides *inter alia*:

Paragraph 8 of the Regulations of the SCC states: 'The proceedings of the Standing Consultative Commission shall be conducted in private. The Standing Consultative Commission may not make its proceedings public except with the express consent of both Commissioners.'

Prior to the special SCC session held in early 1975 to discuss certain questions related to compliance, several articles appeared in various US publications with wide circulation. These articles speculated about the possibility of certain Soviet 'violations' of the SALT agreements which would be discussed, and tended to draw the conclusion that there were violations, based on what was purported to be accurate intelligence information.

The Soviets have expressed to us their concern about the importance of confidentiality in the work of the SCC, and about the publication

of such items that may appear to have official US Government sanction.

We have discussed with the Soviets the usefulness of maintaining the privacy of our negotiations and discussions and limiting speculation in the public media on SCC proceedings, as well as the need to keep the public adequately informed.

The foregoing portion of the compliance report suggests that the Soviet Union is the participant which has primarily stressed the concept of secrecy in the SCC meetings. It is unknown whether one of the "questions related to compliance" raised in 1975 concerned the alleged Soviet lasing of U.S. Air Force satellites over the Indian Ocean. However, it certainly appears a possibility that this forum was invoked to inquire as to the cause of these temporary satellite incapacitations.

²⁰⁵ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 229-33.

²⁰⁶ ABM Treaty, *supra* note 181 art. XIII(1)(c).

²⁰⁷ Peterson, *Carter Sees Soviet Antisatellite Talks*, Wash. Post, Nov. 13, 1977, at A-2.

²⁰⁸ Letter from Douglas J. Bennet, Jr., Assistant Secretary for Congressional Relations, U.S. Department of State to Representative Ronald Dellums, U.S. House of Representatives, (undated official response to Congressional Inquiry dated Oct. 19, 1977)(file copy held by Dept. of State, Washington, D.C.).

²⁰⁹ U.S. Arms Control and Disarmament Agency, *Initial Anti-Satellite Talks End in Helsinki*, (No. 78-14, Washington, D.C. Jun. 17, 1978); Wash. Post, Jun. 18, 1978, at A-28.

²¹⁰ ACDA, *Initial Anti-Satellite Talks End in Helsinki*, *supra* note 209.

²¹¹ *Fiscal Year 1979 Arms Control Impact Statements*, *supra* note 3, at 232. See: Pincus, *Laser Threat to Weapons Control Cited*, Wash. Post, Jul. 2, 1978, at A-1 & A-14.

²¹² See generally: ACDA Release No. 78-4, *supra* note 197, at 1-14.

²¹³ Laird, *Arms Control: The Russians Are Cheating!* Reader's Digest 97-101 (Dec. 1977). Former Secretary of Defense Melvin R. Laird in this article claims that previously withheld evidence now proves by repeatedly violating the SALT I accords, the Soviets are posing a grave threat to U.S. security. Laird discusses a number of alleged Soviet violations of the SALT I agreement in detail.

²¹⁴ See generally: ACDA Agreements, *supra* note 119 in which an extensive range of bilateral and multilateral arms control treaties, both in force and pending ratification, are discussed.

²¹⁵Mallison, *The Laws of War and the Juridical Control of Weapons of Mass Destruction in General and Limited Wars*, 36 Geo. Wash. L. Rev. (no. 2) (Dec. 1967), reprinted in W. Mallison & S. Mallison, *Studies in the International Humanitarian Law of Armed Conflict*, 126, 140-41 (1978)(citations hereinafter are to the reprinted text of this article).

²¹⁶Outer Space Treaty, *supra* note 99 art. III declares that the general international law including the United Nations Charter does apply to outer space:

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, *in accordance with international law, including the Charter of the United Nations*, in the interest of maintaining international peace and security and promoting international co-operation and understanding. (emphasis added)

²¹⁷U.N. Charter art. 2, para. 4; art 51; *See also*: ch. VII arts. 42 & 43 and ch. VIII arts. 52 & 53 in particular.

²¹⁸U.N. Charter art. 2 para. 4.

²¹⁹U.N. Charter ch. VII, art. 42 & 43. In addition, members may be authorized under Chapter VIII, Articles 52 and 53 to carry on enforcement actions through regional arrangements when the requirements of these articles have been met.

²²⁰Mallison, *supra* note 215, at 130.

²²¹R. Moffit, *Modern War and the Laws of War*, 4(Institute of Government Research, Univ. of Ariz., Research Ser. No. 17, Oct. 1973)(manuscript located in U.S. Army Pentagon Library, Washington, D.C.).

²²²U.S. Dept. of Air Force, *International Law--The Conduct of Armed Conflict and Air Operations*, at 1-5 to 1-6 (AFP 110-31, Nov. 19, 1976)(hereinafter referred to in textual material and footnotes as AFP 110-31). AFP 110-31 is not directive in nature and does not promulgate official U.S. Government policy. However, it nevertheless references U.S. Department of Defense and Air Force policy throughout its analysis. *See id.* 1-5 to 1-6 para. 1-3a(1).

²²³*Id.* at 1-6 para. 1-3a(2).

²²⁴*Id.* at 1-6 para. 1-3a(2).

²²⁵Mallison, *supra* note 215 at 131.

²²⁶J. Garner, *International Law and the World War* 282 (1920) *quoted in* Mallison, *supra* note 214, at 140 & 140 n. 73.

²²⁷M. McDougal & F. Feliciano, Law and Minimum World Public Order 77 (1961).

²²⁸Mallison, *supra* note 215, at 157.

²²⁹AFP 110-31, *supra* note 222, at 1-6 para. 1-3a(3). *See also*: Moffit, *supra* note 221, at 3.

²³⁰Stockholm International Peace Research Institute, The Law of War and Dubious Weapons, 36-41 (1976)(hereinafter referred to and cited in textual material and footnotes as the Stockholm Institute or simply as SIPRI)(copies located at U.S. Army Pentagon Library, Washington, D.C.).

²³¹Declaration on the Prohibition of the Use of Nuclear and Thermo-nuclear Weapons, G.A. Res. 1653 (XVI) U.N. GAOR, Supp. (No. 17) 4-5, U.N. Doc. A/5100 (Nov. 24, 1961) *construed in* SIPRI, *supra* note 230, at 38.

²³²SIPRI, *supra* note 230, at 39-41.

²³³*Id.* at 41.

²³⁴*Id.* at 41.

²³⁵*Id.* at 41.

²³⁶*Id.* at 41. With regard to the principle of the threshold, the Stockholm Institute observes:

For the sake of humanity and of survival, this threshold between conventional and nuclear weapons needs to be strengthened, even though it may lead to the outlawing of all nuclear weapons in all circumstances including those in which the use would not generally be unlawful.

The same reasoning applied to the use of tear gases. One can easily imagine circumstances in which the use of these chemical weapons would not be in violation of the traditional laws of war. But any use of gas or chemical weapons might lead to trespassing the threshold existing between conventional warfare and chemical warfare, and thus lead, through escalating, to unrestricted chemical warfare, including the use of forbidden lethal chemical weapons.

²³⁷Mallison, *supra*, note 215, at 160-62. Professor Mallison in discussing claims bearing on chemical weapons in a limited war observes:

It is most unfortunate in terms of the impact upon human values that word-symbols present difficulties in using less harmful and less destructive weapons.(like tear gas) If limited weapons

are to be used in limited wars, the responsible decision-makers must look beyond the labels to the actual effects of particular weapons. *id.* at 161-62.

²³⁸The Declaration of St. Petersburg (1868) *reprinted in* Dept. of Army, International Law Volume II, 40 (Pamphlet 27-161-2, Oct. 1962) (hereinafter in textual material and footnotes referred to as DA 27-161-2). The Law of War-A Documentary History Volume I, 192-93 (L. Friedman ed. 1969).

²³⁹Mallison, *supra* note 215 at 137. The Law of War-A Documentary History *supra* note 238, at 192.

²⁴⁰DA 27-161-2, *supra* note 238, at 40.

²⁴¹Mallison, *supra* note 215, at 137.

²⁴²*Regulations Respecting the Laws and Customs of War on Land*, Regulations Annexed to the Hague Convention IV (1907), art. 23(e), in 2 Scott, note 50, at 153 *quoted in* Mallison, *supra* note 215, at 137.

²⁴³Mallison, *supra* note 215, at 138.

²⁴⁴*Id.* at 138-39. *See generally*: M. Royse Aerial Bombardment, 1-122 (1928). Royse provides an exhaustive discussion on the prohibition of aerial bombardment at the First and Second Hague Conferences.

²⁴⁵Royse, *supra* note 244, at 131-32.

²⁴⁶Mallison, *supra* note 215, at 139.

²⁴⁷*See generally*: ACDA Agreements, *supra* note 119. Both the ABM Treaty, *supra* note 181, and the Interim Agreement, *supra* note 186, are typical examples of agreements which have sought to control essentially efficient weapons systems.

²⁴⁸In the case of the ABM Treaty, the participants are acting to guarantee the credibility of their respective nuclear deterrence forces. Each state seeks to achieve a system which leaves unchallenged the penetration capability of the other's retaliatory missile forces. The overriding interest in maintaining the credibility of the nuclear deterrent to discourage massive coercion was undoubtedly the primary consideration in the states limiting this weapons system.

The nature of the ABM system is such that satellite verification and concomitant reciprocal enforcement of the Treaty is relatively easy to achieve. *See generally*: ACDA Agreements, *supra* note 119, at 130-35. With respect to other arms control agreements, it is generally possible to demonstrate that participants are ultimately acting consistently with their exclusive and inclusive interests. Moreover, those agreements which have substantial impact, typically contain reliable verification and sanctioning or enforcement mechanisms.

²⁴⁹DA 27-161-2, *supra* note 238 at 13-14. In addressing weapons control efforts of the two Hague Conventions, the Department of the Army publication observes:

The limits that were attempted to be imposed upon the use of weapons by the First and Second Hague Conventions proved to be inadequate in the first war in which they were tested. The reason for this lay with the rules themselves. They would not easily be extended to cover new weapons. Therefore, such weapons were employed largely in a legal vacuum. In addition, the rules were the vaguest where the interests of states were the most vital. Items such as lances with barbed heads, glass filled shells, and poison were interpreted as absolutely forbidden. However, atomic weapons, flamethrowers, napalm, and chemical and biological weapons were not. War had long since outgrown the specifically prohibited weapons. The more modern instruments were only forbidden *if* military necessity did not require their use.

²⁵⁰*Id.* at 40 art. 22. The Law of War-A Documentary History, *supra* note 238, at 318 art. 22.

²⁵¹DA 27-161-2, *supra* at 40 art. 23(c) (sic) The Law of War-A Documentary History, *supra* note 238, at 318 art. 23(e). A conventional principle or concept closely related to the avoidance of unnecessary suffering arises out of the Annex to the Regulations of the Hague Convention II of 1899. Article 23(e) of the Annex to the Regulations Respecting the Laws and Customs of War on Land provided: "Besides the prohibitions provided by special Conventions, it is especially prohibited . . . To employ arms, projectiles, or material of a nature to cause *superfluous injury*". (emphasis added); The Law of War-A Documentary History, *supra* note 238, at 229 art. 23(e).

²⁵²DA 27-161-2, *supra* note 238, at 40. The Law of War-A Documentary History *supra* note 238, at 192.

²⁵³AFP 110-31, *supra* note 222, at 6-2 para. 6-3b(2).

²⁵⁴*Id.* at para. 6-3b(2).

²⁵⁵*Id.* at 6-2 para. 6-3b(2).

²⁵⁶Mallison, *supra* note 215, at 142-43.

²⁵⁷Geneva Protocol for the Prohibition of the Use of War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare of 1925 3 Hudson, International Legislation 1670 (1931) 26 U.S.T. 571; T.I.A.S. No. 8061; 94 L.N.T.S. 65 (1975).

²⁵⁸The 1925 Geneva Gas Protocol entered into force for the United States, April 10, 1975. *See generally*: APF 110-31 *supra* note 222, at 6-4 para. 6-4c.

²⁵⁹SIPRI, *supra* note 230, at 17.

²⁶⁰*Id.* at 18-19.

²⁶¹*Id.* at 18.

²⁶²J. Fuller, *The Conduct of War 1789-1961*, 108 (1961) *quoted in* SIPRI, *supra* note 230, at 22.

²⁶³SIPRI, *supra* note 230, at 22. The SIPRI study speaks of the "concept of coercive warfare" in preference to the term "unrestricted warfare" employed in this study.

²⁶⁴*Id.* at 23.

²⁶⁵V. Sokolovskiy, *Soviet Military Strategy* 174 (3rd ed. 1968) *quoted in* SIPRI, *supra* note 230, at 23.

²⁶⁶SIPRI, *supra* note 230, at 24 observes:

Terror can be a successful tool in some circumstances, but experience has taught that it sometimes has the opposite effect and induces grim rage and blind fury. The expectations expressed in the advice of Professor Lindemann to Churchill 'that having one's house demolished is the most damaging to morale', and that the bombing of the 58 German towns of over 100 000 inhabitants 'would break the spirit of the people' proved to be wrong. The bombing of Germany had little effect, nor had the bombing of Japan. Extensive research into the effectiveness of bombing in World War II, including the U.S. *Strategic Bombing Survey*, conducted directly after the war, has established that any militarily 'favourable effect' on the population's morale was very slight. (original footnotes omitted)

²⁶⁷McDougal & Feliciano, *supra* note 227, at 615 & 615 n. 288.

²⁶⁸Royse, *supra* note 244 at 166. *See also*: Nussbaum, *A Concise History of the Law of Nations* 17-18 (rev. ed. 1954); Mallison, *supra* note 215 at 136.

²⁶⁹McDougal & Feliciano, *supra* note 227 at 615.

²⁷⁰APF 110-31, *supra* note 222, at 6-7 para. 6-7a.

²⁷¹Dept. of Army, The Law of Land Warfare, 18, para. 35 (Field Manual 27-10, Jul. 18, 1956)(hereinafter in text and footnotes referred to as FM 27-10). FM 27-10 provides authoritative guidance to U.S. military personnel on the customary and treaty law applicable to the conduct of warfare on land and to the relationships between belligerents and neutral States. Paragraph 35 provides an official statement regarding U.S. policy toward "atomic weapons":

The use of explosive 'atomic weapons,' whether by air, sea, or land forces, cannot as such be regarded as violative of international law in the absence of any customary rule of international law or international convention restricting their employment.

This perspective essentially provides an exception to Article 23(e) of the Annex to the Regulations to the Hague Convention IV of 1907.

²⁷²*Supra* p. 103 & n. 228.

²⁷³Mallison, *supra* note 215, at 141.

²⁷⁴AFP 110-31, *supra* note 222, at 6-7 para. 6-7a.

²⁷⁵*Id.* at 6-7 para. 6-7a.

²⁷⁶*Id.* at 6-3 para. 6-3c.

²⁷⁷*Id.* at 6-3 para. 6-3c.

²⁷⁸ICRC 1973 Report, *supra* note 24, at 69 paras. 241 & 242.

²⁷⁹Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 57.

²⁸⁰AFP 110-31, *supra* note 222, at 6-7 para. 6-7a.

²⁸¹*Id.* at 6-7 para. 6-7a.

²⁸²*Supra* nn. 238 & 242.

²⁸³AFP 110-31, *supra* note 222 at 6-2 para. 6-3b(2).

²⁸⁴*Id.* at 6-2 para. 6-3b(2).

²⁸⁵ICRC 1973 Report, *supra* note 24, at 69 paras. 241 & 242.

²⁸⁶*Id.* at 69 para. 241.

²⁸⁷*Supra* pp. 12-14.

²⁸⁸SIPRI, *supra* note 230, at 37-39.

²⁸⁹*Supra* pp. 7-14 & 27-28.

²⁹⁰ABM Treaty, *supra* note 181 art. XII(2).

²⁹¹*Id.* Preamble.

²⁹²SIPRI, *supra* note 230, at 39-41.

²⁹³Prohibition of Action to Influence the Environment and Climate for Military and Other Purposes Incompatible with the Maintenance of International Security, Human Well-Being and Health, G.A. Res. 3264 (XXIX) U.N. GAOR Supp. (No. 31) 27-29, U.N. Doc. A/9631 (Dec. 9, 1974); SIPRI, *supra* note 230 at 39.

²⁹⁴Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 58.

²⁹⁵SIPRI, *supra* note 230 at 40-41.

²⁹⁶Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (also referred to as the Environmental Modification Treaty) May 18, 1977 (as of July 20, 1978, U.S. Dept. of State indicates 18 parties had ratified and deposited instruments to that effect with the repository. Twenty states are required to ratify the Treaty prior to its entering into force. The United States had signed the Treaty but had not ratified it. Accordingly, as of July 1978, the United States was not formally bound by the Treaty. A complete text of the Treaty is *reprinted in* ACDA Agreements, *supra* note 119, at 183. Treaty not registered as of July 1978 in any standard treaty series).

²⁹⁷McDougal & Feliciano, *supra* note 227, at 77-78.

²⁹⁸ICRC 1973 Report, *supra* note 24, at 58-60.

²⁹⁹*Id.* at 58-59.

³⁰⁰*Id.* at 60-61.

³⁰¹*Id.* at 61.

³⁰²*Id.* at 61-63.

³⁰³SIPRI, *supra* note 230, at 63-68. *See generally*: Report of the Secretary-General, Napalm and other Incendiary Weapons and all Aspects of their Possible Use (A/8803/Rev. 1, 1973).

³⁰⁴Draft Hague Rules of Air Warfare (1923) art. 18. For full text of the Rules, *see* Greenspan, *The Modern Law of Land Warfare* 650 (1959). For discussion, *see* Spaight, *Air Power and War Rights* 197 (1947). *See also*: SIPRI, *supra* note 230, at 65.

³⁰⁵SIPRI, *supra* note 230, at 65.

³⁰⁶*Id.* at 65.

³⁰⁷FM 27-10, *supra* note 271, at 18 para. 36.

³⁰⁸SIPRI, *supra* note 230, at 66.

³⁰⁹*Id.* at 68.

³¹⁰Protocol Additional to the Geneva Convention of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I) (Jun. 10, 1977) (complete copy of Protocol I published by International Committee of the Red Cross, *Protocols additional to the Geneva Conventions of 12 August 1949*, 3 (Geneva, 1977)) (hereinafter referred to in the textual materials and footnotes as Protocol I). The United States Department of State indicates that as of July 20, 1978, the United States had not ratified either Protocol I or Protocol II. These Protocols had not been formally registered with any treaty series as of that date.

³¹¹Mallison, *supra* note 215, at 151.

³¹²*U.S. v. Ohlendorf, 4 Trials of War Criminals Before the Nuremberg Military Tribunals* 493 (1950) quoted in AFP 110-31 *supra* note 222, at 10-3 para. 10-7a.

³¹³Protocol I, *supra* note 310, arts. 20, pt. IV, sec. I various arts. *See generally*: AFP 110-31, *supra* note 222, para. 10-7.

³¹⁴Complaint by Yemen, S/RES/188, 19 U.N. SCOR (1111th mtg.) 9-10, U.N. Doc. S/INF/19/Rev. 1, (Apr. 9, 1964). *See*: SIPRI, *supra* note 230 at 47 n. 1.

³¹⁵FM 27-10, *supra* note 271, at 18 para. 36.

³¹⁶AFP 110-31, *supra* note 222, at 6-6 to 6-7 para. 6-6c.

³¹⁷*Id.* at 6-7 to 6-7 para. 6-6c.

³¹⁸Protocol I, *supra* note 310, art. 48.

³¹⁹SIPRI, *supra* note 230 at 68.

³²⁰Incendiary and Other Specific Conventional Weapons Which may be the Subject of Prohibition or Restrictions of Use for Humanitarian Reasons, G.A. Res. 152 (XXXII) U.N. Press Release (GA/5723 Jan. 5, 1978) 127-29 (Dec. 19, 1977)(Copy held by Office of Public Information Press Section, U.N. New York & U.N. Information Center and Library, Washington, D.C). *See also*: Follow-Up Regarding Prohibition or Restriction of Use of Certain Conventional Weapons, Res. 22 of Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts (Jun. 9, 1977) *reprinted in* International Committee of the Red Cross, Protocols additional to the Geneva Conventions of 12 August 1949 at 117-19 (Geneva, 1977). Resolution 22 urges consultations be undertaken and a meeting of all interested governments be convened for addressing the work of the Government Experts concerning controls over the use of specific conventional weapons. The resolution further recommends that a preparatory committee seek to establish the best possible basis for achieving agreement among participants. Finally, the Diplomatic Conference through this instrument invites the General Assembly at its thirty-second session to consider further action that may be necessary for holding a conference in 1979.

³²¹Klass, *Special Report: Laser Weapons-3*, *supra* note 5, at 53.

³²²AFP 110-31, *supra* note 222, at 5-17 n. 17.

³²³*Id.* at 11-2 para. 11-2.

³²⁴Dept. of Navy, Office of the Judge Advocate General, Off the Record, 13 (No. 72, Mar. 13, 1978)(periodical professional publication circulated to officers of U.S. Navy Judge Advocate General's Corps).

³²⁵Protocol I, *supra* note 310, at 3, Preamble.

³²⁶*Id.* art. 1 paras. 1, 2 & 3.

³²⁷Embassy of Switzerland Notification of Federal Political Department To States Parties to the Geneva Conventions of August 12, 1949, for the Protection of War Victims, Concerning the Signature of the Protocols I and II Adopted on June 8, 1977 by the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts (and attached selected party Declarations of Signature) at 2, para. A(1), (Jan. 16, 1978)(Copy on file at U.S. Dept. of State, Washington, D.C.).

³²⁸*Id.* at Declaration 4 para. 1(i).

³²⁹Protocol I, *supra* note 310, art. 35.

³³⁰*Supra* 112.

³³¹*Supra* 113 & n. 251.

³³²Baxter, *Conventional Weapons Under Legal Prohibitions*, International Security 43 (Winter 1977); Robblee, *The Legitimacy of Modern Conventional Weaponry* 71 Mil. L. Rev. 104 at 117-21 (1976).

³³³U.S. Dept. of Defense Working Group Analysis (Sept. 12, 1977) at I-35-2 (unpublished copy held by Prof. W. T. Mallison Jr., Geo. Wash. Univ. Sch. of Law, Washington, D.C.) (hereinafter cited as DoD Working Group Analysis).

³³⁴Protocol I, *supra* note 310, art. 55.

³³⁵1975 U.S. Delegation Report *quoted in* DoD Working Group Analysis, *supra* note 333 at I-35-2.

³³⁶DoD Working Group Analysis, *supra* note 333, at I-35-2 to I-35-6.

³³⁷Protocol I, *supra* note 310, art. 36.

³³⁸DoD Working Group Analysis, *supra* note 333, at I-36-2.

³³⁹Dept. of Defense, Review of Legality of Weapons Under International Law, 1-3 (DoD Inst. 5500.15, Oct. 16, 1974).

³⁴⁰*Id.* at 2 para. IV(A)(1).

³⁴¹*Id.* at 2 para. IV(B).

³⁴²*Id.* at 2 para. IV(D).

³⁴³Protocol I, *supra* note 310, art. 51(4).

³⁴⁴*Id.* art. 51(5).

³⁴⁵*Id.* art. 51(6).

³⁴⁶*Id.* arts. 85-91.

³⁴⁷ICRC 1975 Report, *supra* note 91, at 1.

³⁴⁸ICRC 1973 Report, *supra* note 24, at 67-69 paras. 235-42.

³⁴⁹G.A. Res. 152 (XXXII), *supra* note 320.

³⁵⁰Prohibition of the Development and Manufacture of New Types of Weapons of Mass Destruction and New Systems of Such Weapons, G.A. Res. 3479 (XXX) U.N. GAOR, Supp. (No. 34)23, U.N. Doc. A/10034 (Dec. 11, 1975). *See also*: Annex: U.S.S.R. Draft Agreement on the Prohibition of the Development and Manufacture of New Types of Weapons of Mass Destruction and New Systems of Such Weapons, *id.* 29-30; Prohibition of the Development and Manufacture of New Types of Weapons of Mass Destruction and New Systems of Such Weapons, G.A. Res. 84A (XXXII) U.N. Press Release (GA/5723, Jan 5, 1978) 106 (Dec. 12, 1977) (copy held by Office of Public Information Press Section, U.N. New York & U.N. Information Center and Library, Washington, D.C.).

³⁵¹Prohibition of the Development and Manufacture of New Types of Weapons of Mass Destruction and New Systems of Such Weapons, G.A. Res. 74 (XXXI) U.N. GAOR, Supp. (No. 39) 39, U.N. Doc. A/31/39 (Dec. 10, 1976) cited in G.A. Res. 84A (XXXII), *supra* note 350.

³⁵²United Nations General Assembly, Report of the Conference of the Committee on Disarmament Volume I, 32 U.N. GAOR 62-69, paras. 207-34, Supp. (No. 27) U.N. Doc. A/32/27 (1977).

³⁵³*Id.* at 63 para. 213.

³⁵⁴*Id.* at 65 para. 220.

³⁵⁵*Id.* at 67 para. 225.

³⁵⁶*Id.* at 67 para. 226.

³⁵⁷*Id.* at 66-67 para. 224.

³⁵⁸*Fiscal Year 1979 Arms Control Impact Statements, supra* note 3, at 155.

³⁵⁹*Id.* at 232.

³⁶⁰G.A. Res. 84A (XXXII), *supra* note 350 & G.A. Res. 84B (XXXII), *supra* note 155.

³⁶¹G.A. Res. 84A (XXXII), *supra* note 350 para. 3.

³⁶²G.A. Res. 84B (XXXII), *supra* note 155 para. 1.

³⁶³*Id.* para. 3.

³⁶⁴McDougal, Lasswell & Vlasic, *supra* note 1 at 483.

³⁶⁵Beane, *supra* note 4, at 104-05. Beane proffers three hypothetical cases covering the principal "operational readiness" possibilities as he sees them. In the first case, the U.S. and U.S.S.R. achieve operational readiness concurrently. In the second and third cases, the U.S. and U.S.S.R. each respectively acquire possession of an operational high-energy laser six months ahead of the other. The author expresses particular concern for the inherent dangers involved in the latter two cases.

³⁶⁶McDougal, Lasswell & Vlasic, *supra* note 1, at 475-76. The authors discuss a proposal put forward by Professor Gomer of the University of Chicago in: Gomer, *Some Thoughts on Arms Control* 17 Bull. Atom. Sci. 133 (1961). Gomer proposed that an "armed arbiter" possessing military force sufficient to deter any state from engaging in impermissible coercion. He is quoted *id.* at 135 as favoring an "arbiter" which would be "capable of massive and prompt retaliation against any aggressor, be determined to retaliate, be impervious to surprise attack, be able to detect and identify aggression and have some inspection rights."

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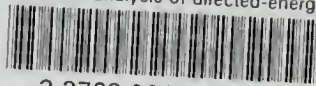
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